ENGINEERING AND MINING JOURNAL

A McGRAW-HILL PUBLICATION

FEBRUARY 1961

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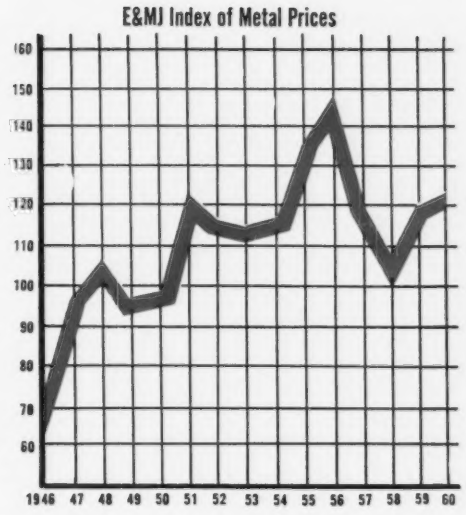

92ND Annual Survey And Outlook

GOLD
SILVER
COPPER
LEAD
ZINC
ALUMINUM
URANIUM
IRON ORE & STEEL
MAGNESIUM
TITANIUM
TIN
MERCURY
LITHIUM
BERYLLIUM
BORON
SEMI-CONDUCTORS
COLUMBIUM-TANTALUM
ZIRCONIUM
ANTIMONY
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BISMUTH
PLATINUM
THORIUM
RARE EARTHS
NICKEL
COBALT
MANGANESE
CHROMIUM
TUNGSTEN
MOLYBDENUM
SULPHUR
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BARITE
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Under your pumping conditions,

economical efficiency depends on having precisely the

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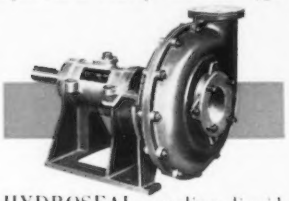
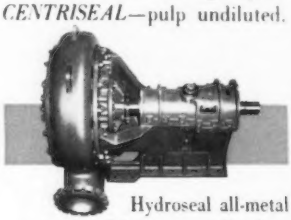


HYDROSEAL—sealing liquid.
CENTRISEAL—pulp undiluted.



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P&H is the no. 1 choice of the mining industries

In recent years 68% of all American made 4.5 to 9 yard electric mining shovels bought for use throughout the world have been P&H

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Your satisfaction with these advantages has made us The *World's Largest Builder of Full-electric Shovels*. Compare before you buy—write for complete information.

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Mining Calendar

International Symposium on Mining Research, University of Missouri, Rolla, Mo., Feb. 21-25 1961

AIME annual meeting, Chase-Park Plaza and Ambassador Hotels, St. Louis, Feb. 26-March 2 1961

Western Mineral Congress, Ambassador Hotel, Los Angeles, March 20-24 1961

Fourth Symposium on Rock Mechanics, Pennsylvania State University, University Park, Pa., March 30-April 1 1961

Computers and Computer Applications in the Mineral Industry, a short course sponsored by the Colleges of Mines and of Engineering, University of Arizona, Tucson, April 4-7

Sixth Annual Mining Minerals and Petroleum Conference, Southwestern Alaskan chapter, AIME, Anchorage, April 7-9

American Society of Mechanical Engineers, 33rd annual conference and oil and gas power exhibit, Jung Hotel, New Orleans, April 10-13

International Symposium on Agglomeration, Philadelphia, April 12-14 1961

Wyoming Mining Association Convention, Rawlins, Wyo., April 21-22 1961

AIME-Southwest Mineral Industry Conference, Stardust Hotel, Las Vegas, Nev., April 24-25 1961

High Temperature Materials Conference, Cleveland Section, AIME, Hotel Pick-Carter, Cleveland, April 26-27 1961

16th Purdue Industrial Waste Conference, Purdue Memorial Center, Lafayette, Ind., May 2-4

Sixth Annual Uranium Symposium, Grants, N.M., May 12-14 1961

37th annual conference of the Lake Superior Mines Safety Council, Hotel Duluth, Duluth, Minn., May 25-26

11th National Chemical exposition, Chicago Section, American Chemical Society, Chicago, Sept. 5-8

Commemoration of the 50th Anniversary of Froth Flotation in the U.S., sponsored by MBD of SME, Cosmopolitan Hotel, Denver, Sept. 17-20 1961

Northwest Mining Association Convention, Davenport Hotel, Spokane, Wash., Dec. 2-3 1961

Coming Up

E&MJ's annual index for Volume 161, the year 1960, is now available free upon request. Please address

Reprint Department
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94th YEAR OF PUBLICATION

ENGINEERING AND MINING JOURNAL

FEBRUARY 1961

A McGRAW-HILL PUBLICATION

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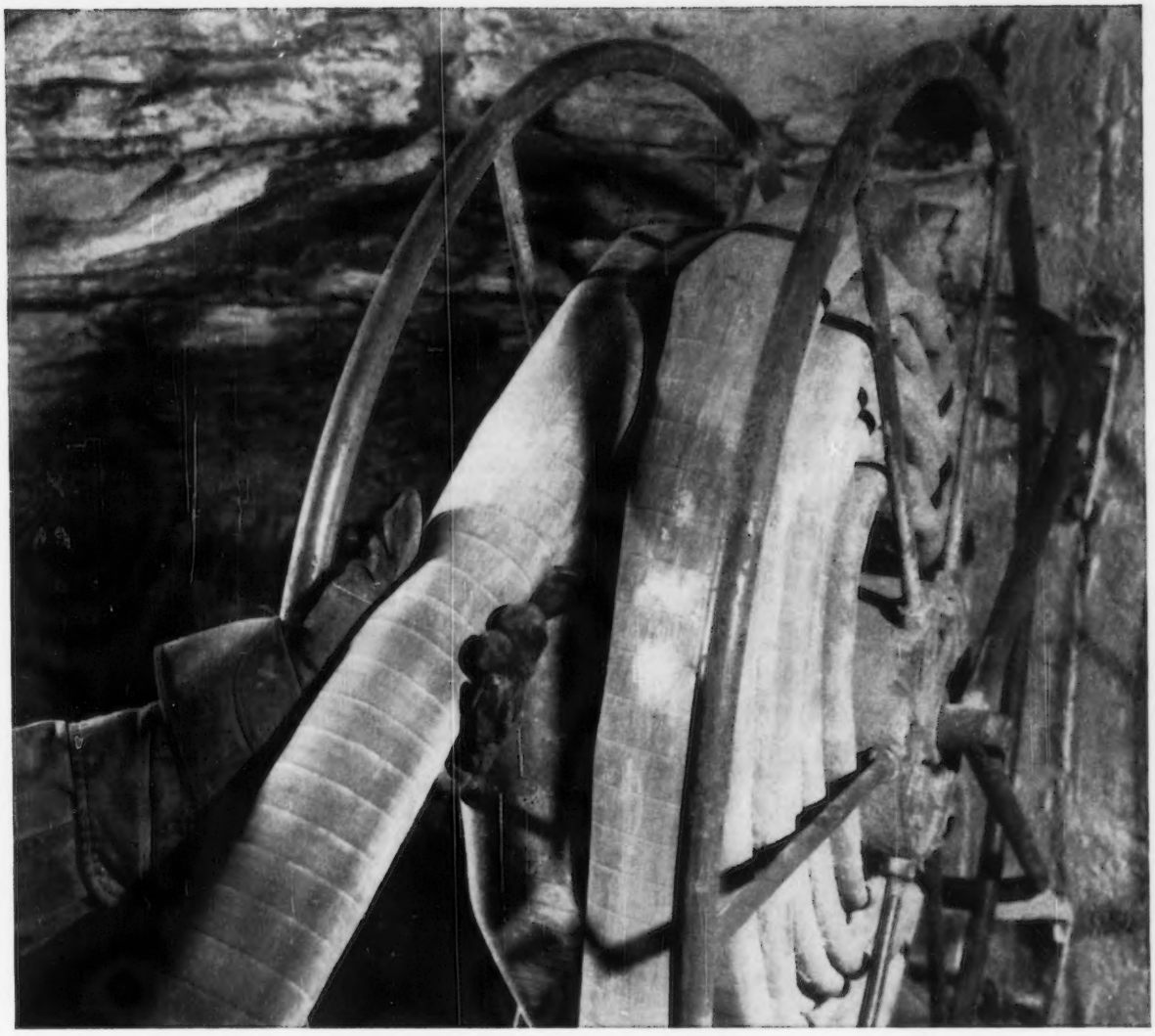

Mine operator claims this fire hose has three lives

Service life jumps from 6 to 18 months with B.F.Goodrich hose

IN this underground mine, fire hose had to be replaced every six months. Acid, water and mine dampness caused cotton-jacketed hose to mildew and rot. Hose life was further shortened by constant exposure to abrasive dolomite dust.

Then a B.F.Goodrich distributor told the mine superintendent about a new industrial fire hose, developed by B.F. Goodrich to overcome just such problems. A special rubber compound was developed for the cover of B.F.Goodrich Pinnacle hose to give it high resistance to acids, chemicals, weather, abrasion and just about everything else that ruins regular hose.

After 1½ years in this underground mine, this improved B.F.Goodrich hose showed no sign of mildew or rot. The operators expected it to last far longer than any hose used previously.

The use of Dacron, a chemically produced fiber, as "filler cords" in the woven jacket makes this hose extra light, more flexible, easier to handle. It weighs only half as much as regular rubber-covered hose, takes far less storage space whether coiled or folded.

Your B.F.Goodrich distributor has exact specifications for this hose. And, as a factory-trained specialist in rubber products, he can answer your questions about the many rubber products B.F.Goodrich makes for industry. *B.F.Goodrich Industrial Products Co., Dept. M-962, Akron 18, Ohio.*

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Articles in this issue of

ENGINEERING AND MINING JOURNAL

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134 A New Frontier in Crushing Rock

Allis-Chalmers Manufacturing Co. and a group of Soviet researchers have independently developed an electro-hydraulic device which breaks and drills rock by shooting high-voltage sparks at rock surfaces under water. The forces are created by the spark as it is transmitted through the liquid and also by the cavitation impact which results when the liquid rushes back into the void created when the spark is extinguished. High pressures, amounting to several hundred atmospheres, are said to break rock within the vicinity of the spark.

Research to date by Allis-Chalmers has indicated several limitations to the technique. The best performance obtained resulted in an energy expenditure at least ten times as great as with conventional crushers. Other limitations seem to be the short life of the condensers, electro-erosion of the tips of the underwater electrodes, and failure of the resinous insulation of the electrodes within a relatively short period.

70 The Annual Survey and Outlook Issue

For the 92nd time in a row, the editors present herewith a series of articles on the major metals and nonmetallic minerals: their activity last year, their economic health, the condition of their frequently palpitating markets, and a reasonable guess for their futures.

Some 40-odd authors have contributed to the 92nd Annual Survey, each man a careful student of his particular commodity, and most, men who live with their particular subjects all year long.

There are some impressive bright spots in the dappled mineral landscape of 1960, notably in the commodities which have attracted interest outside the traditional basic supplies of the world's industry. And some of those basic metals which are usually tied to the fortunes of the steel industry seem to have fared better than steel itself. Once again, technology is expanding commercial applications and recovery of minerals and, once again, events all around the world are creating pronounced effects on markets, production and trade.

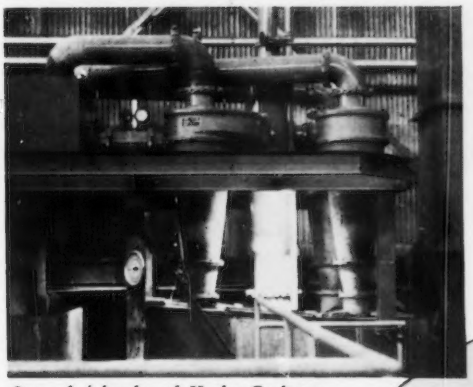
151 This Month — and Last Year — in Mining

As their contribution to the annual thrash which we call the survey and outlook issue, E&MJ's world-wide string of correspondents have almost unanimously taken a page from the mining reviews and done a fair spot of surveying of their respective beats. Mineral production, important political developments, new projects and new discoveries are popping up all around the globe and our own "Beaver Patrol" has been chasing them. The roundups extend clear back to the regional news.

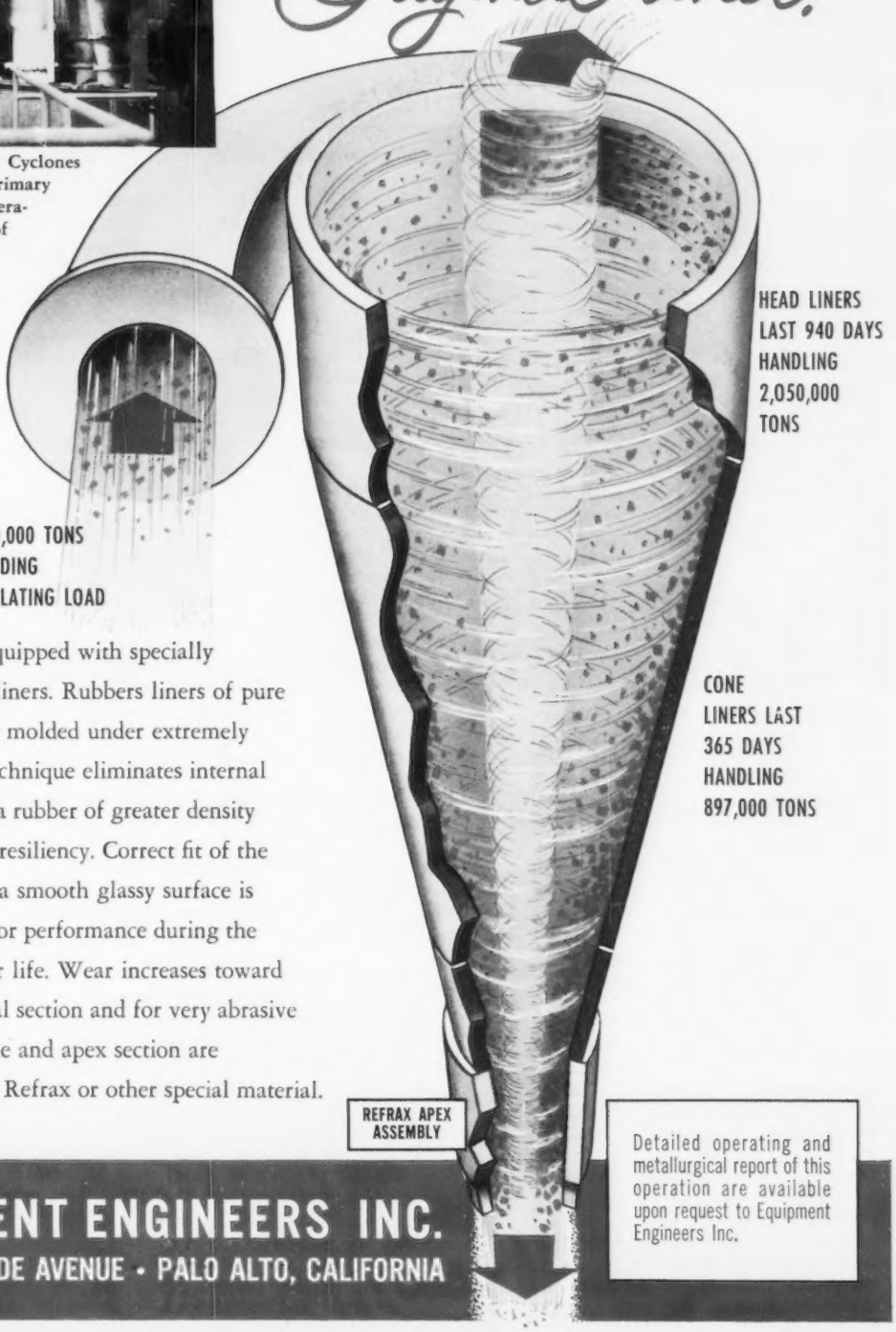
130 How the "Average Mining Engineer" Is Being Educated

As a contribution to the current lively discussion on mining education sponsored by the AIME in cooperation with industry and educators, two authorities have analyzed the curricula of 29 mining schools, and tabulated the requirements of the schools. Their comments should provide a stimulus for further constructive discussion of the mining engineering problem.

Each KREBS CYCLONE handles 2,050,000 tons of primary ball mill discharge with *Original liner!*



One of 4 banks of Krebs Cyclones (4 in each bank) in primary closed-circuit grinding operation at Silver Bell unit of American Smelting and Refining Company.



Krebs Cyclones are equipped with specially designed replaceable liners. Rubbers liners of pure gum or Neoprene are molded under extremely high pressure. This technique eliminates internal porosity, resulting in a rubber of greater density without reducing the resiliency. Correct fit of the liners is assured, and a smooth glassy surface is maintained for superior performance during the greatly extended wear life. Wear increases toward the apex of the conical section and for very abrasive slurries the lower cone and apex section are frequently lined with Refrax or other special material.

Detailed operating and metallurgical report of this operation are available upon request to Equipment Engineers Inc.

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94 YEARS OF MINING

The following news items are reprinted substantially as they first appeared in the AMERICAN JOURNAL OF MINING, the publication which became *E&MJ*.

MICHIGAN, MAY 1866—There is a great lack of furnaces in the Lake Superior region, as is evidenced by the enormous quantities of ore that are being shipped to ports down the lake, where the cost of smelting is greatly enhanced. Furnaces at the mines is the cheapest and best economy.

NEVADA, MAY 1866—The TERRITORIAL ENTERPRISE reports that the New York and Silver Peak Gold and Silver Mining Company will commence in the course of a few days to build a new mill of the largest size and of the most substantial character. The inside works will comprise all of the new and important appliances known to the scientific and practical miner for the reduction and amalgamating of the ore and the saving of the metals therefrom.

CALIFORNIA, MAY 1866—At the State's quarry a blast was recently put in, which threw out one piece of granite, without seam or flaw, 90 feet long, 60 feet deep, and 24 feet thick. It is doubtful if there is another quarry known were so large and perfect an ashler could be obtained. The granite is for the new State Capitol, and it is estimated that this piece will, when divided, furnish enough stone to more than half complete it.

IDAHO, MAY 1866—The STATESMAN reports that Baume and Mapps are reducing quartz without the use of stamps, or crushing mills. "We selected a piece of quartz so hard that it could be broken with difficulty, and in about five minutes Mr. De La Baume made it almost as soft as well burned lime. In a word, the disintegration was perfect. M. D. la Baume assures us that the necessary chemicals will not cost more than one dollar per ton. The plan is to roast the ore in a perpetual furnace, after which it is subjected to a chemical bath, which completely disintegrates the rock. In the composition of this bath consists the invention."

This month in

ENGINEERING AND MINING JOURNAL

Continued from p4

Behind the By-Lines

There are some months when the size of this book just won't stay put. We've put quite a strain on the covers (and on the printer's patience) many times in the past, but this month it was really hard to get the boys turned off.

It is, of course, the 92nd Annual Survey & Outlook Issue, and that's usually sufficient to keep us all well occupied until the late hours of February the One: but this month there were even more, and more.

First came a most exciting article on a pretty far-out rock-breaking technique. We say far-out in the sense that using ammonium nitrate as a blasting agent is pretty far-out, or that drilling through to the earth's mantle is far-out.

Our good friends at Allis-Chalmers told us about their research in the field of electro-hydraulics, and we'd heard that a team of Russian scientists were also investigating it. The whole story of the project to date, thanks to our friends in Milwaukee, starts back on p 134.

The second addition to this issue, but one that just couldn't wait for March, is the article on education in the mining industry. It's all part of a plot we've nurtured for some time now, and is an outgrowth of the education questionnaire we asked you to fill out in the December issue.

What we've learned since then, and what we're still learning from the mailing of a second questionnaire to some top mining people, will be delivered by Al Knoerr at the AIME meeting in St. Louis this month—and subsequently will be part of an article appraising the entire problem of education and today's mining men.

For your part in developing our knowledge, our thanks.

A lot of our old friends are back for the review issue: friends from industry and the Bureau of Mines. And, once again, they've stepped out on a few limbs after taking a thoughtful look at the year just past. The whole affair begins on p 70.

We are particularly grateful to Donald Irving, Assistant to the Chief, Division of Minerals, USBM, for his help and guidance in putting the issue together, and in original planning.

And speaking of old friends, we are saddened to note the passing of Walter A. Rukeyser, of Montreal, a mining engineer of world renown and a long-time friend of E&MJ.

He died Oct. 16, at his home, suddenly.

Walter received his mining degree from Princeton in 1916 and devoted the greater part of his professional life to the asbestos industry. In 1930, he worked in the Soviet Union as a consulting and supervising engineer and was the author of "Working for the Soviets: An American Engineer in Russia," published in 1932.

His first by-line in E&MJ was in January 1932, and he was a regular contributor from that time. This year would have been his tenth anniversary as the asbestos author for the Survey & Outlook issue.

Walter was the epitome of the modern mining engineer: warm, friendly, restless, curious, interesting and interested. His dedication to accuracy and completeness of coverage made working with him an inspiration and a pleasure.

ENGINEER'S FIELD REPORT

100% overload... yet RPM DELO Oil cuts maintenance costs at Bunker Hill

Bunker Hill Mining Co., Kellogg, Idaho, is one of the world's largest miners of high-grade metals, producing over 500,000 tons of lead, zinc, and silver ore annually. And much of the work is done by diesel powered equipment ... using dependable RPM DELO Oils.

"We've reduced engine wear despite tough operating conditions," reports Shop Foreman Maurice Lyons. "Our diesel equipment often operates at 100% overload working with heavy materials like this granulated slag pile, above. Yet "RPM DELO" gives us the protection we need to keep equipment out of the shop and on the job."

RPM DELO Oil is one of 44 Standard Oil products used at Bunker Hill to lubricate over 25,000 pieces of equipment. The master lubrication plan for this huge fleet, prepared by Standard Engineers, has saved thousands of dollars in maintenance costs alone.

RPM DELO Oil reduces wear and prolongs engine life, protects vital parts whether engine is running or idle. Special detergent keeps parts clean, while anti-oxidant fights lacquer and gum formation problems. Other additives cut bearing corrosion and crankcase foaming.

Why not try RPM DELO Oil? Chances are it can cut your costs, lengthen equipment life. Just call your local representative, or write any company listed below:

LUBRICATING OILS RPM DELO

STANDARD OIL COMPANY OF CALIFORNIA, San Francisco 20 • **STANDARD OIL COMPANY OF TEXAS,** El Paso
CALIFORNIA OIL COMPANY, Perth Amboy, New Jersey - Denver, Colorado

TRADEMARK "RPM DELO" AND CHEVRON DESIGN REG. U.S. PAT. OFF.

Save on construction costs with the new '61 FORD TRUCKS

NEW SUPER DUTIES CUT OPERATING COSTS, GIVE PROVEN DURABILITY THAT'S BACKED BY A 100,000-MILE ENGINE WARRANTY

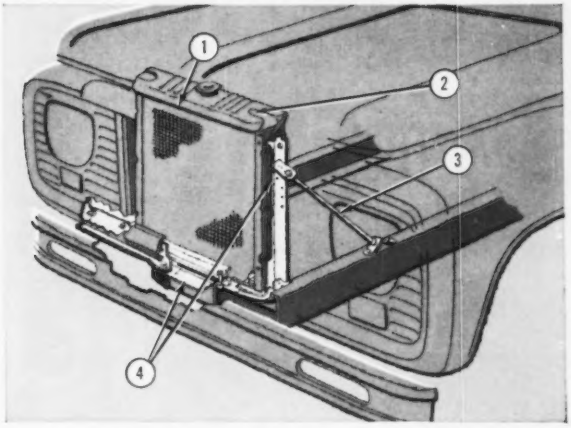
New 100,000-mile warranty on Super Duty V-8 gas engines is the most liberal in the industry. On 401-, 477- and 534-cu. in. V-8's, Ford Dealers will replace any major engine part (including block, heads, crankshaft, bearings, valves, pistons, rings) found to be defective in materials and workmanship providing trucks are used in normal service. The warranty covers full cost of replacement parts for 100,000 miles or 24 months, whichever occurs first . . . full labor costs for first year or 50,000 miles, sliding percentage scale thereafter. Never before have you had such protection . . . such evidence of long-term durability!

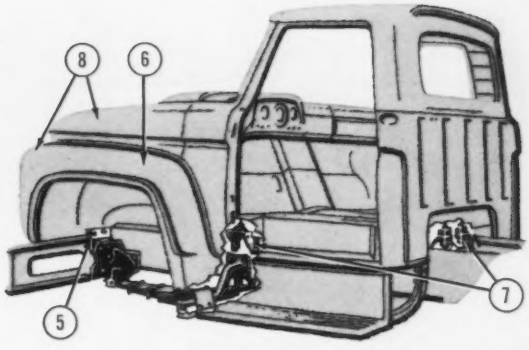
And you save with greater gas economy! Certified tests prove the new Super Duty V-8's give up to 20% better mileage. In addition, Ford's new lightweight, *extra-hi-tensile* single-channel frames (standard F-850—F-1000) give you long-lived durability combined with a lightness of weight for added payloads. All in all, you get proven components and design features . . . in trucks built for easier maintenance and lower running costs.

Save with Ford T-Series Super Duty Tandems for exceptional durability, big payloads and low operating expenses. Ford T-850 and T-950 Tandems with Super Duty V-8 engines have rugged double-channel, hi-tensile frames for maximum strength, minimum weight. And they provide a wider range of chassis options so you can choose the right power train and load-carrying components for any job. Eaton and Timken rear axles are now available in bogie assemblies with up to 38,000-lb. capacity. And lightweight aluminum walking beams, wheels and gas tanks are available to keep chassis weights low . . . payloads high.

Ask your dealer about Ford's full tandem line . . . five T-Series with GVW's ranging from 28,000 lb. to 51,000 lb. and GCW's up to 75,000 lb.

SAVE WITH NEW HEAVY-DUTY CONSTRUCTION THAT DOUBLES CAB, SHEET METAL AND RADIATOR LIFE





① **Save with Ford's exclusive "lock-seam" radiator construction** that doubles the solder area at key seams for greatly increased strength and longer radiator life.

② **Save with heavier-gauge metal on radiator tank and header.** Tanks and header have thicker walls to resist vibration, jolts and corrosion for greater reliability.

③ **Save with independent radiator mountings,** separate from front-end sheet metal. This means that road shocks and shakes are not transmitted to the radiator through sheet metal . . . tanks, tubes and connections last longer, require less maintenance.

④ **Save with "horse collar" mounting** for extended radiator life. This new mounting on resilient rubber at the center of frame cross member soaks up any frame flexing . . . cuts wear and tear on entire cooling system.

⑤ **Save with independent fender mountings.** Fenders are bolted to a rubber-cushioned transverse bracket at the front and a frame-mounted bracket at the rear. This mounting, independent of both cab and radiator, eliminates stress transfers for increased fender life.

⑥ **Save with removable fenders.** The quick and easy removal of only 8 bolts per fender provides faster service accessibility to the engine area, saving valuable maintenance time.

⑦ **Save with new 3-point cab mounting system** for greater cab durability. Two outboard front mounts plus a centered "twin" rear mount provide a triangular system that holds the cab stationary while allowing the frame to move independently . . . reducing strain on the cab.

⑧ **Save with 42% heavier-gauge sheet metal** in fenders, hood, cab floor pan and toeboard for greater strength, greater durability.

Save with Ford's new Full-Torque flywheel power take-off . . . now available on T-750's and up, to power construction equipment like transit mixers. It's much simpler and more efficient than long, complicated hookups needed with the front-end drives. And the flywheel PTO is lighter in weight—only 105 pounds—for greater payloads.

FORD TRUCKS COST LESS

YOUR FORD DEALER'S "CERTIFIED ECONOMY BOOK" PROVES IT FOR SURE...

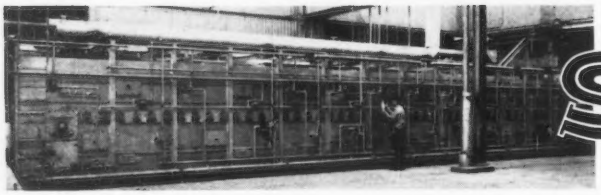
FORD DIVISION, *Ford Motor Company*

For iron, carbon and alloy steel castings

CAPITOL FOUNDRY DIVISION

has unmatched facilities

Quality



Service

Delivery

DESIGN WITH STEEL CASTINGS Centennial 1861-1961 STRENGTH IN SHAPE

Quality that's inherent in the use of all the latest foundry techniques *plus* experience that stretches back over the years. All melting is performed in electric furnaces.

Service that stems from the operation of a production foundry in Capitol's new and modern 208,000 square foot facilities.

Delivery schedules that are fast and flexible for standard castings as well as specialty items in such metals as gray iron, Ni-hard iron, carbon, chrome-moly, manganese, and Austenitic manganese steel. A-3106A

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NATIONAL MALLEABLE and STEEL **CASTINGS COMPANY**

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JOY HYDRO DRILL JIBS

have cut drilling costs in all kinds of mines

IRON

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ZINC

COPPER

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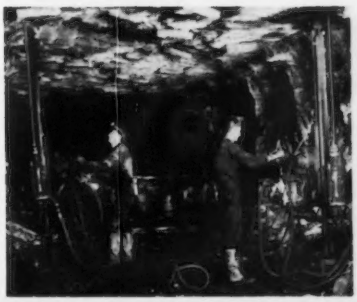
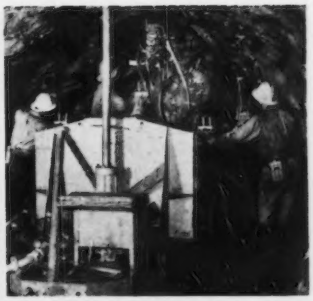
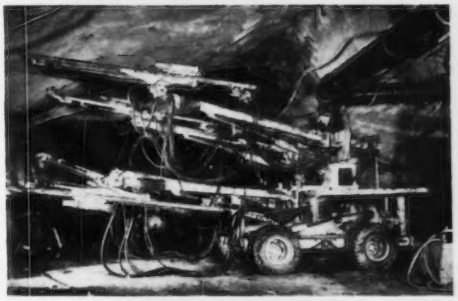
URANIUM



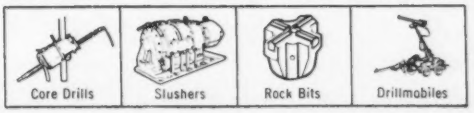




Joy Hydro Drill Jibs have been cutting drilling costs in all kinds of mines ever since hydraulic jibs were pioneered by Joy in 1934. Five models enable Joy engineers to provide the jibs best suited to any particular conditions, assuring the most efficient drilling operation. Jibs can be mounted on tractors, trucks, mine cars or jumbos, or on Joy's specially designed line of Drillmobiles. Joy drifters are available for holes up to 6".

When you need drill jibs, talk to the Joy man in your area. He represents the company with the most drilling experience and the most complete line of drilling equipment in the world. For further details on Joy Hydro Drill Jibs, write for Bulletin 2637-4.

EQUIPMENT FOR MINING... FOR ALL INDUSTRY



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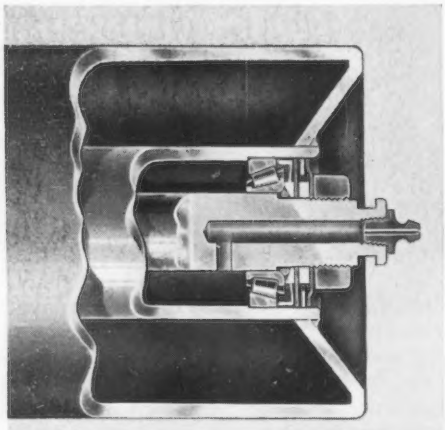
broadest line of quality idlers at lowest price



HEAVY-DUTY IDLER FEATURES: exclusive combination nylon-and-metal face and labyrinth seal; tapered roller bearings; exclusive neoprene rubber "O" ring; material-shedding recessed roll ends; large capacity grease reservoir; and fittings that provide direct lubrication of each roll.

These are just a few of the Barber-Greene features that assure you of the most idler for your money:

- Broadest line—more than 800 different types and styles in four complete series, offering an idler exactly right for your conveyors.
- Larger bearings give longer service under most adverse conditions.
- Larger diameter, solid through-shafts of special high-alloy steel maintain roll alignment.
- Most advanced grease seals on the market assure maximum bearing life.
- Die-formed steel end and center brackets withstand far more punishment than malleable iron.
- Heavy self-shedding base angle ensures alignment, prevents material build-up under rolls.
- Rolls shells fabricated from heavy steel tubing of uniform wall thickness for even wear and balance.
- End cups 100% welded to roll shell forming sealed, rugged, extra-duty roll.
- Positive lubrication of each bearing prolongs bearing life.
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See your Barber-Greene Distributor for today's best buy in idlers . . . or the most imaginative and economical design for your conveyor system.

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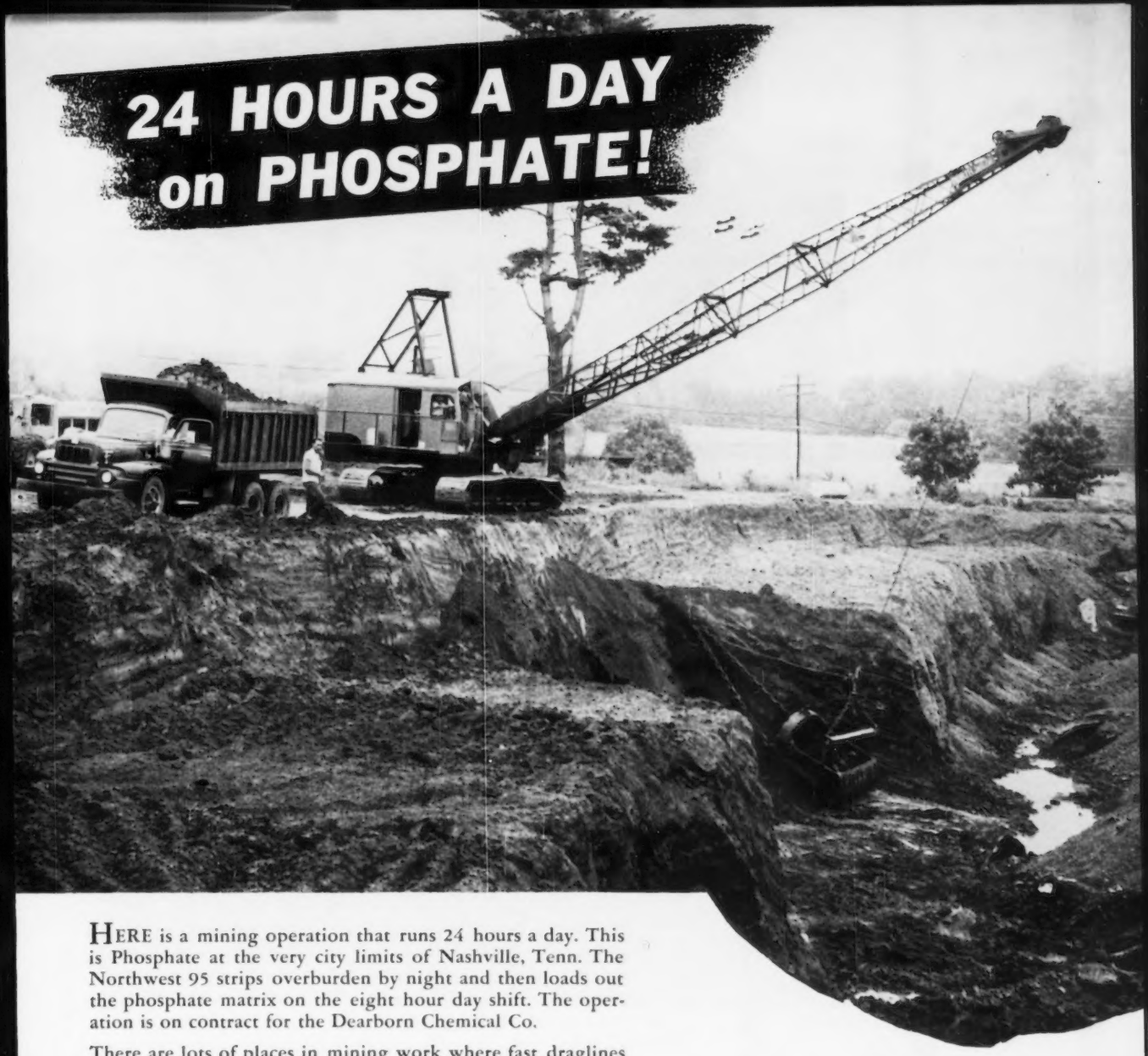
24 HOURS A DAY on PHOSPHATE!



HERE is a mining operation that runs 24 hours a day. This is Phosphate at the very city limits of Nashville, Tenn. The Northwest 95 strips overburden by night and then loads out the phosphate matrix on the eight hour day shift. The operation is on contract for the Dearborn Chemical Co.

There are lots of places in mining work where fast draglines of the 95 capacity can serve (up to 3 cu. yds.). These machines get around in conditions that would cause long delays for bigger rigs. They can be put over mine or public roads without damage. Positive Traction on both crawler treads while turning as well as when going straight ahead take them in and out of places that give other rigs trouble.

Cast Alloy Steel Machinery Bases and Machinery Side Frames take the shocks of digging and eliminate the rebuilding often characteristic of structural frames. Swing clutches are large — Uniform Pressure Swing Clutches that need no fans or special cooling devices. The Feather-Touch Clutch Control gives ease of operation with the true feel of the load. Often these fast rigs can get greater output than larger machines particularly where frequent moving is a condition of the job.

Northwests, both shovels and draglines, are serving on many mining operations — in uranium, iron, copper, phosphate and in many other kinds of ore.

There are many features of interest to a mining man. Let us tell you more about them.

NORTHWEST

CRANES • SHOVELS • DRAGLINES
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3/4 to 3 Cu. Yd. Capacity

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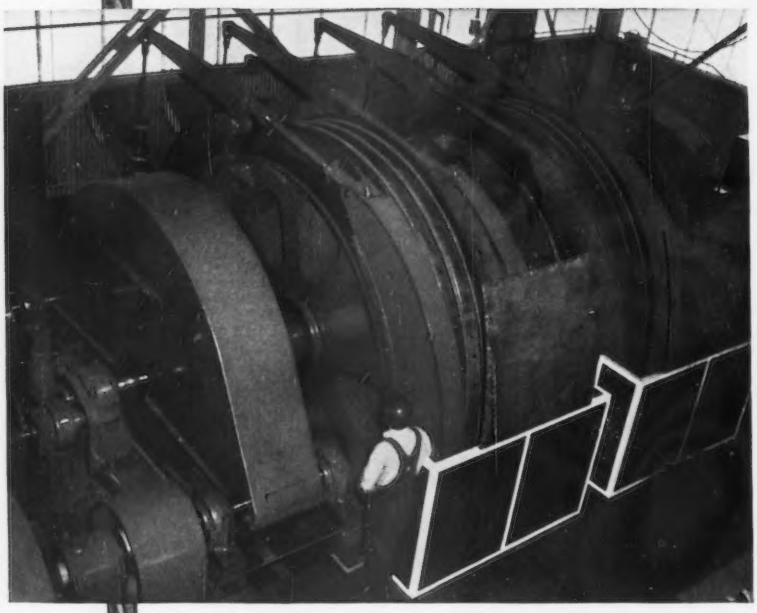

Hoists in the shaft tower.

Steel

For strength
. . . economy
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BETHANIZED WIRE ROPE SERVES HOISTS IN NEW HOMER-WAUSECA SHAFT

These friction hoists in the Homer-Wauseca iron ore mine are operated at Iron River, Mich., by the M. A. Hanna Co. The capacity of the hoists is 300 long tons per hour at 1,500-ft depth per hoist. The twelve hoist ropes used on the three lifts, 2,900-ft long, are 1-in. 6 x 27 H Bethanized Form-Set, improved plow steel, flattened strand, with fiber core. The 2,810-ft tail ropes are 1⅜-in. 18 x 7 Form-Set, traction steel, right lay, with fiber core, in Bethanized A and B coatings. The Bethanized coatings of high-purity zinc are applied electrolytically to the individual wires. Since the amount of lubrication on the ropes must be limited to maintain friction, the Bethanized coatings were chosen to provide extra corrosion-resistance.

Whatever the lifting assignment, you can count on Bethlehem Wire Rope for top performance . . . every time.

BETHLEHEM STEEL COMPANY, Bethlehem, Pa.
Export Sales: Bethlehem Steel Export Corporation

BETHLEHEM STEEL

There's a distributor of Bethlehem Rope near you, supplied by our nationwide network of wire rope mill depots.

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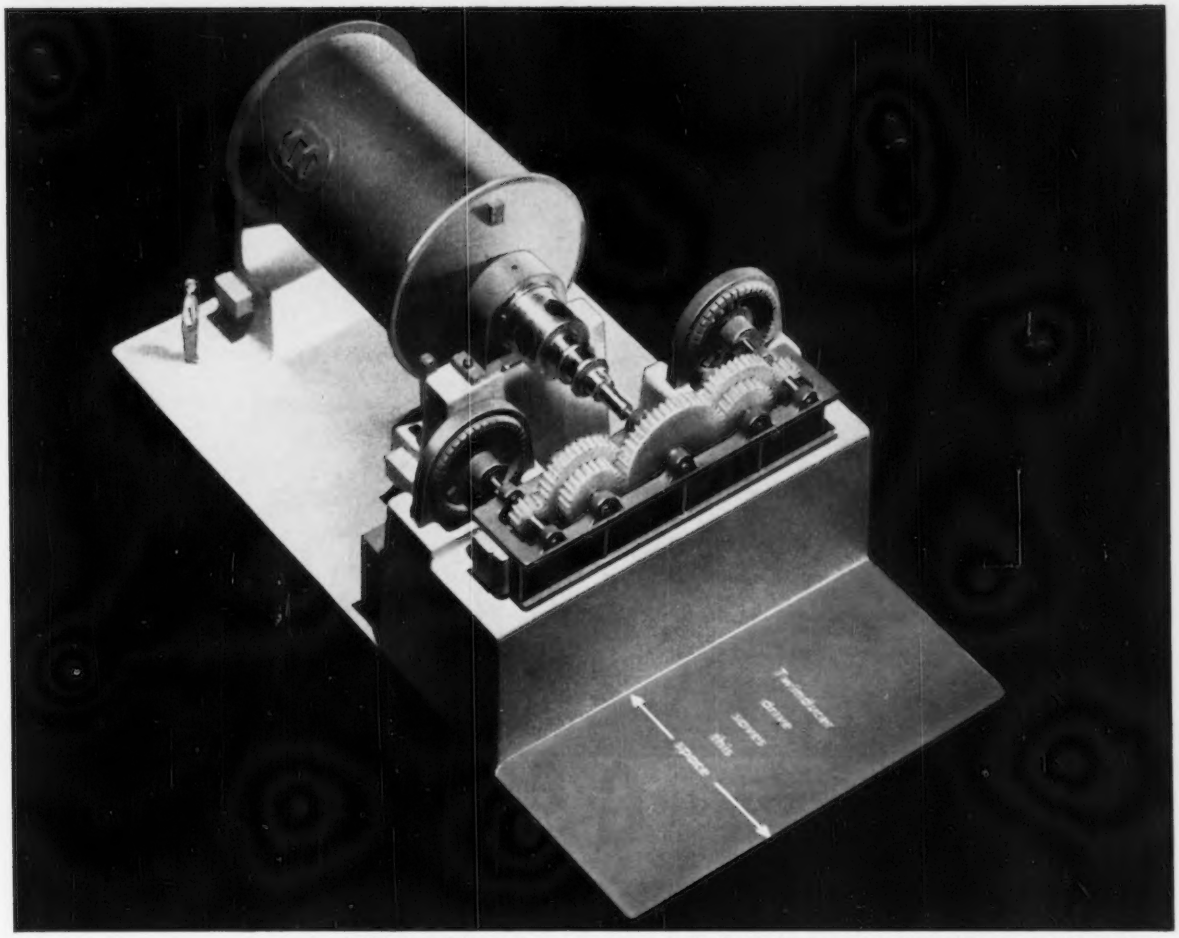


A 2000-hp **Twinducer** drive mill conserves up to 16 feet of space compared to other trunnion drive designs.

Twinducer drive saves on space and wear...

divides mill loads electrically

Another Allis-Chalmers first — *Twinducer* drive mill — creates new space savings, new long-range operating and maintenance economies.

Dynamic electrical load distribution is accomplished through rotor shift of one of the two motors. Once the load is balanced and the rotor locked in place, there is no need for further adjustment. No need for a floating gear or pinion, either, since electrical, not mechanical, balancing is employed with *Twinducer* drive.

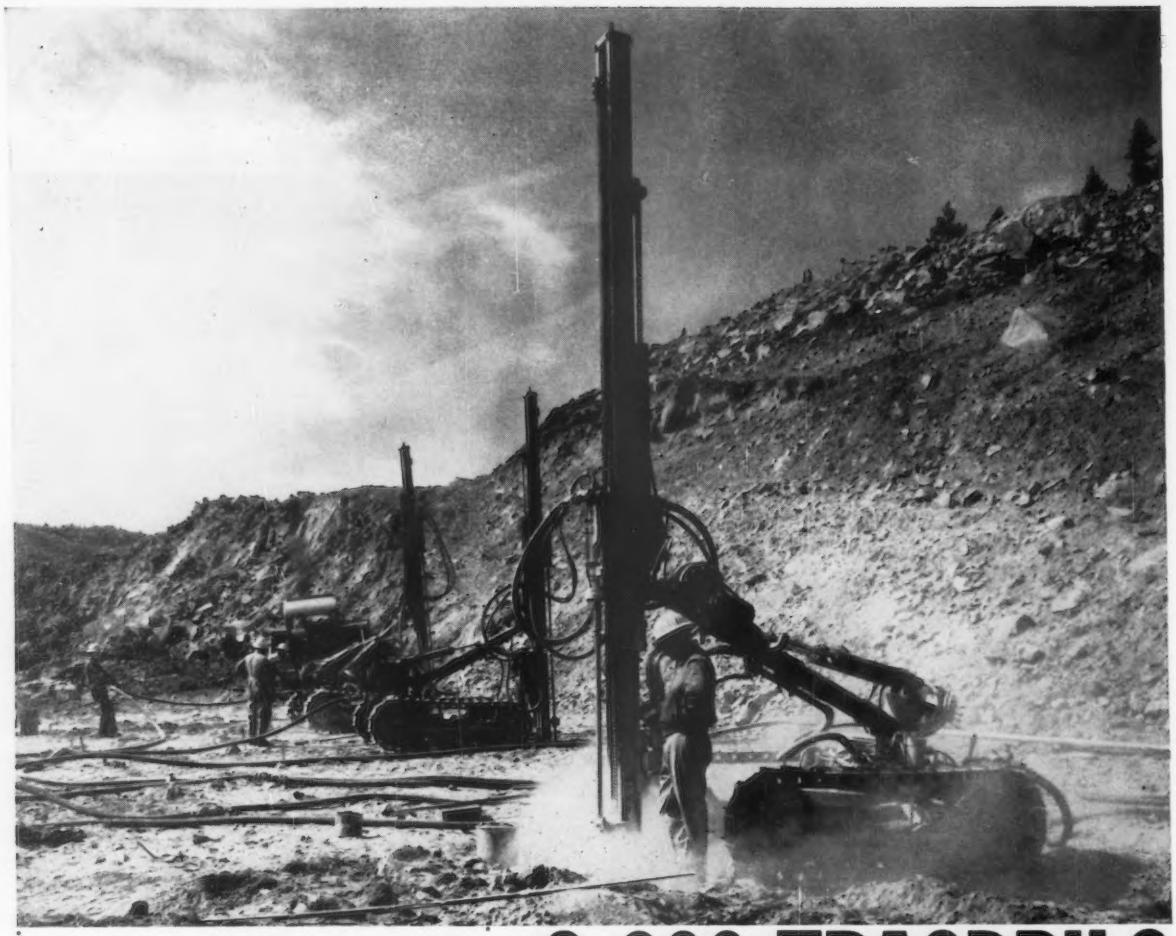
Gears and pinions experience less wear because they are fixed. Wear is further reduced because the gear train runs in a filtered oil bath, promoting longer gear life through both splash and flood lubrication.

Twinducer drive efficiently harnesses the power of *two* synchronous motors located on the mill side of the drive. This unique, compact arrangement reduces drive dimensions drastically . . . as much as 16 feet on a 2000-hp drive.

Twinducer drive promotes better housekeeping, too. No lubricant leakage because the system is enclosed. No oversized foundations, no pits to collect waste materials and dirt.

Ask your A-C representative about the outstanding features of Twinducer drive mills. **Allis-Chalmers,** *Industrial Equipment Division, Milwaukee 1, Wis.*

Twinducer is an Allis-Chalmers trademark. A-1365



ABOVE: G-900 TRACDRILS with "Hydra-poise" knee-action have unmatched maneuverability and stability to sink blast holes in any formation. Independently operated, extra-long crawlers provide 1350 square inches of ground contact. Two sets of grouped controls—one at turret, the other at boom end—save time and steps for driller.

BELOW: A battery of "POWER VANE" ROTARY COMPRESSORS, supplies air to a group of G-900 Tracdrils on a big project. Used singly or in batteries, "Power Vane" Rotaries have the "Go-Power" you need to keep your air-powered equipment producing at full capacity.

G-900 TRACDRILS

are at their best in the toughest terrains and formations

...let their power and stamina deliver more blast holes per shift for you! Mention treacherous footing and hard rock and you've got a job for Chicago Pneumatic G-900 Tracdrils and "Power Vane" Rotary Compressors.

Operators find the new G-900 a mining man's drill. It's got everything a driller expects from a high production rig... plus some real exclusives, too! It can drill directly alongside tracks with 180° full boom swing. It handles horizontals 11 feet high at the face, or snake holes at ground level. And you can't beat the G-900 for safety. Release the throttle and heavy-duty brakes lock automatically... keep drill from shifting or creeping... hold hard on really bad ground.

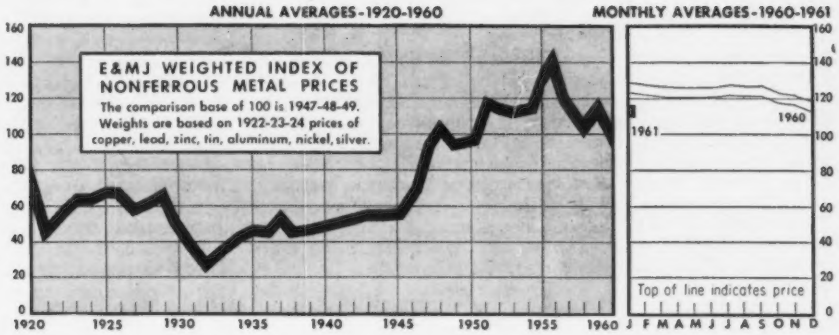
Backed up by rugged, always reliable CP-600 "Power Vane" Rotary Compressors with the "Go-Power" to meet every air demand, you can lick the toughest formations you'll ever find. Write for your copy of the new bulletin SP-3267 on the revolutionary G-900 Tracdril. *Chicago Pneumatic Tool Company, 8 East 44th Street, New York 17, New York.*

Chicago Pneumatic

TRACDRILS • AIR COMPRESSORS • PNEUMATIC TOOLS • AIR WRENCHES • REICHdrills

E&MJ OUTLOOK

PRICES


ANNUAL AVERAGES-1920-1960
MONTHLY AVERAGES-1960-1961
E&MJ WEIGHTED INDEX OF NONFERROUS METAL PRICES
The comparison base of 100 is 1947-48-49. Weights are based on 1922-23-24 prices of copper, lead, zinc, tin, aluminum, nickel, silver.
1960
1961
Top of line indicates price
J F M A M J J A S O N D

MARKETS

Substantially lower prices for copper, lead, zinc and tin accounted for the continued decline of the E&MJ nonferrous metals price index from 118.7 in December to 116.1 in January.

Silver prices would have to rise 25 to 30% before mine operators would be tempted to open new mines or reopen abandoned diggings according to a recent NEW YORK TIMES article quoting Simon Strauss, vice president of American Smelting and Refining Co. Foreseeing depletion of the Treasury's free bullion stocks by late 1962 or early 1963, Strauss proposed that the Treasury use a "ratchet system" to permit the silver market to move from present levels to a higher price. Under the proposed system, the Treasury should sell each month only at the average London market price for the preceding month. London now averages about a cent or so above the New York price at present. Strauss suggests that no sales be made whatever when the price drops. This would permit the market to move gradually to the higher level.

•

AT HOME

Little Squaw Mining Co., of Spokane, Wash., announced that development work at the company's Alaskan property had indicated more than $1-million worth of gold ore. A 135-ft ore zone with a mining width of about 10 ft has been opened up. The company is owned jointly by Grandview Mines, and Metaline Mining & Leasing Co.

Work on American Potash & Chemical Corp.'s new $5-million manganese metal plant at Aberdeen, Miss., has been started.

•

LABOR

Mine Mill officials are urging abolition of U.S. import quotas on lead and zinc—and federal subsidies to guarantee annual returns on newly mined copper, lead and zinc. The quota system, says Mine-Mill, is a failure, as it didn't revive lead-zinc mining. Brass imports, they urge, should be decreased to restore jobs to Americans, lost because of stiff foreign competition.

•

ABROAD

Iron ore extraction in Russia last year was 107-million tons, a 12.1-million ton increase over production for 1959, according to the Central Statistical Board. (See p 196.)

Vast iron ore deposits (more than 2-billion metric tons) combined with cheap hydroelectric power potential in the Guayana area of southeastern Venezuela are being developed to "create the conditions that will attract industry," says President Romulo Betancourt. Also under development are considerable deposits of manganese, bauxite, coal, and diamonds. The project, to last a period of years, will begin with the construction of the government's hydroelectric and steel plants.

THIS MONTH IN MINING

New Theories and Some Rivals at Rolla Mining Symposium

WHEN THE AUTHORS bring their papers to the International Symposium on Mining Research, Rolla, Mo., Feb. 21 to 25, they will be introducing much new factual data as well as new mining techniques. Some of the conclusions are slightly controversial, indicating different directions in research by the different authors. The performance of slurries vs AN/fuel oil mixtures is one such example.

Intermountain Research & Engineering Co. has been working with slurries for a considerable time and has developed a "DBA" (Dense Blasting Agent) series. The latest of these, DBA-3, an improved small diameter slurry with 33% Composition B and other slurries sensitized with smokeless powder, is designed for underground use. It is able to propagate unconfined in diameters less than one inch.

The authors, D. T. Bailey, R. B. Clay, M. A. Cook, and D. H. Pack, will explain how DBA-3, substituted for 55 weight strength dynamite, can to varying degrees (1) reduce the number of holes per round, (2) reduce the necessary diameter of the holes and (3) reduce the total weight of explosive per round.

On the other hand, for bench blasting, Ulf Langefors, Sweden, will show the superiority of AN/fuel oil mixtures over slurries. According to Langefors, "Compared with AN in crystal form and with the maximum density for AN-oil that in Sweden in practical experiments have been reached, the cost may be in a definite favor for the AN-oil alternative."

Several factors are important in Langefors' conclusions: One is that the AN be in crystal form and not in prills. Another is that the dynamite primer be pneumatically loaded in the bottom of the hole. A third is that Swedish AN is treated with a special surface-active organic coating and is not guhr coated.

With respect to AN-fuel oil mixtures, Robert J. Grubb will explain the mixes that American Cyanamid Co. found gives optimum sensitivity. According to Grubb, "We believe that the explosive sensitivity and strength of an ammonium nitrate-fuel system are dependent upon (1) the ammonium nitrate particle size and size distribution, (2) the degree of intimacy of mixing of the ammonium nitrate and fuel, and (3) the stoichiometry or weight proportions of the ammonium nitrate and fuel. Further we believe that there are no unique sensitivity properties of an ammonium-nitrate-fuel mixture that cannot be explained by knowledge of the above three factors."

In regard to the three factors, American Cynamid found that maximum sensitivity is reached when (1) up to 20% by weight of the ammonium nitrate has a particle size of minus 200 mesh, (2) the AN is mixed with a low viscosity liquid rather than a high viscosity liquid, and (3) the AN/fuel oil mix is 94.5/5.5 (standard guhr coating).

An interesting concept in loading explosives will be offered by N. V. Mel'nikov, Russia, in a paper relating to the utilization of explosive energy for breaking rock. Mel'nikov concludes, "Efficiency of the fragmentation is augmented by dividing the charge into several sections, with air spaces in between, by a simultaneous explosion of the entire charges and by creating an air space between the charge and the stemming."

Mel'nikov's conclusion is based on the development of a concept that categorizes energy according to the work it does, rather than to types produced by an explosion. In this classification, energy is first divided between that expended in expulsion or fragmentation of rock, and further divided into (1) that transmitted to rock, (2) residual chemical energy, (3) that retained by the products of the explosion, (4) heating the rock, (5) fragmentation energy and (6) energy expelled into the air. Experiments show that only 15 to 20% of the total energy is fragmentation energy.

In regard to stemming, Gunnar Johnsson experimented with a rock salt model and concludes, "with bottom priming and for charge columns larger than one meter, stemming has practically no influence on efficiency (could not be determined). For collar priming, the influence of stemming is always measurable."

Two new explosive loaders will be described to the symposium members. One of these is a pneumatic cartridge loader to be described by C. H. Johansson, Sweden. The other is an air-operated mixing-loading unit for AN/fuel oil mixtures, used at Boliden Mining Co.'s mines, which will be described by Ulf Henning.

The air-operated cartridge loader, according to Johansson, "has proved indispensable in under-water blasting, in blasting through overburden and in longhole excavation. It is used in an ever increased scale for other kinds of rock blasting." Since bulk-handling is one of the chief assets of AN, a more proper comparison of dynamite and AN can be made if the dynamite is bulk-handled in a device such as this.

With Boliden's mixing-loading unit, one man starts with mixing the charge and operates the unit by remote control during loading. According to Henning, "Spill is, even in upward inclined and vertical holes, usually not more than 5%. Loading efficiency is higher than with usual dynamite loading methods, especially in longhole stoping."

J. J. Calaman and H. C. Roseth will tell of the technical advances made in jet piercing in the taconite industry. This will be the first progress report made by the Linde Co., a division of Union Carbide Corp., since 1952. The authors will tell of technical advances that result in over-all operating cost reductions in the order of 25% per ton of crude ore, and of progress being made in automating the operation.

According to the authors, "The first portable liquid oxygen storage unit designed for jet piercing application, now in operation at a Mesabi taconite pit, will be cited as an example of technological advance in the handling of cryogenic fluids by means of improved storage and distribution equipment, with substantial reductions in both capital investment and cost of delivering process fluids to the jet piercing machine."

Otto Rellensmann will describe some recent applications of the gyro-theodolite in tunneling work, in underground workings and in applied geophysics. The gyro-theodolite, a development of the Mine-Surveying Institute of Mining-University Clausthal, West-Germany, is a new type of meridian-indicator. According to Rellensmann, "This instrument is used for running traverses above ground and underground, for tunneling work and for applied geophysics by determining with aid of a magnetic needle on each setup the declination. . . . Abnormal values of declination indicate the presence of magnetic orebodies."

A few of the many applications of the instrument are: (1) Finding a true azimuth at any time independent of the weather above ground or underground, (2) traversing by occupying every other station, (3) plumbing of shafts (Only one plumb line is needed to carry the coordinates underground), (4) finding magnetic declination, etc.

A method to control overbreak by presplitting will be explained by R. S. Paine, D. K. Holmes and H. E. Clark, who define presplitting "as the establishment of a free surface of shear plane in rock by the controlled usage of explosives and blasting accessories in appropriately aligned and spaced drill holes." The authors found through experimentation that presplitting is faster, cheaper, and gives a cleaner and more accurate break line than line drilling, modified line drilling and cushion blasting.

According to the authors, "Presplitting consists of taping one-half a cartridge of 1¼x8-in. gelatin-type explosive on 12-in. centers on the full length of a piece of Primacord equal to the depth of the hole. Holes are drilled on varying centers from 12-in. to 2-ft, depending on the rock conditions. On the 2-ft-centers, each hole is loaded and then a Primacord trunk line hookup is made and several holes are fired using an electric blasting cap at each end of the trunk line. The splitting between these break-line holes is done before any blast pattern is drilled and fired."

Many of the symposium papers will cover rock mechanics, both theoretical and practical. One recent strain-measuring development, based on photoelasticity, will be explained by C. L. Emery. By combining the use of photoelastic samples in the laboratory with rock bolt dynamometers and other gauges which consist of mechanisms using direct reading photoelastic discs, it is possible to institute a direct underground control system. An extension of the techniques permits measurement of primitive strains in rocks.

According to Emery, "It now appears possible to plot primitive strains in and around an ore body from the diamond drill core normally taken for mineralogical evaluation of the deposit. If proper precautions are observed, the mining engineer teamed with the geologist should be able to evaluate the operative stress field distribution as the geologist evaluates the mineral distribution. It then follows that rational mine design is possible in advance of any mining operation."

Research work by John S. Rhinehart continues to add to our knowledge of transient stress waves and the work they do in breaking rock. Rhinehart will explain, among other things, how the velocity of propagation of the wave is strongly dependent on the state of stress and rock type and how attenuation varies greatly also with rock type as well as with frequency.

Other papers dealing with rock mechanics include a discussion of the time factor in mining subsidence by J. T. Whetton and H. J. King. The time element is also emphasized in a paper by G. Vigier, who notes, "One of the essential points to notice and study is the dying-out tendency of the movements."

A progress report, by Charles E. Mongan, Jr. and Thomas C. Miller, will tell symposium members the status of the sonic technique in exploring roofs.

Present and potential applications of the gamma-ray spectrometer will be discussed by John Mero, G. M. Gordon and L. E. Shaffer, who will also discuss the analysis of ores by X-ray fluorescence spectroscopy.

In regard to ore analysis by gamma-ray spectroscopy, the authors explain, "It is largely a matter of time and money before techniques and equipment are developed that will permit instantaneous analysis of ores for many contained elements down a borehole, at the mine face, on a conveyor belt, in a mill slurry, in a mill solution, in a mill product or in mill tails."

With the present high interest in the transportation of solids in pipelines as slurries, Fred L. Smith's paper, "Dynamic Similarity in Liquid-Solid Systems in Pipelines," should receive much attention. Smith will discuss the effect of changes in the particle size and gradation of the solids and effect of changes in the liquid ratio on the flow properties of various materials, among other things.

(Continued on p 153)

As We Went to Press . . .

$650-million will be invested in Chilean mining operations within the next 10 years—part of a $9,300-million, 10-year Corporacion de Fomento plan to boost national economy by increasing production and decreasing costs.

Kennecott and Anaconda will invest $320-million to increase copper output by about 400-million lb. Half of this total will be in dollars, i.e., machinery and materials to be imported, and the other half will be spent in Chilean currency within the country. Other American companies will invest $330-million among the following projects and commodities: replacement of obsolescent plants and machinery ($155-million); medium size and small copper mines ($122-million); iron ore ($44-million), and nitrate ($9-million). The government will invest $9.5-million (Chilean currency) in the Ventanas copper smelter that will smelt 60% of the 240,000 tons of copper ore exported annually.

The Atomic Energy Commission has announced uranium purchases from South Africa will be made directly with the South African Atomic Energy Board. Previously South African uranium was purchased by the Combined Development Agency—a joint U.S.-United Kingdom uranium procurement agency. The new U.S. contract (effective from Jan. 1) incorporates changes in the concentrate pricing arrangement and delivery schedules. Price per lb. will be $11.20 including shipment—60¢ per lb less than last year's CDA's prices. The U.S. plans to purchase 18,900 tons of U_3O_8 between Jan. 1, 1961, and Dec. 31, 1966 under this new agreement. (See Uranium, p. 88)

Construction work in excess of $20-million will be started in 1961 in Quebec and Newfoundland in connection with the Wabush Lake iron ore project of the Wabush Iron Co. Projects planned to further development of large-scale mining are: a 25-mile railway, to be built from the harbor site to Mile 8 on the QNS&LRR, the dredging for and building of an ore loading dock, rough grading of the service and ore storage area at the dock site, and the building of service facilities. This will cost about $15-million. Housing and other preliminary structures will be built at a cost of approximately $5-million. (See E&MJ, December 1959.)

Empire Mining Co., operated by the Cleveland-Cliffs Iron Co. will construct a high grade iron ore pellet-producing property, mining low-grade jasper ore, near Neguanee, Mich. Ore will be mined by open pit, up-graded to a plus 65%, and will be pelletized. First output will be at 1-million tpy.

A new high-grade uranium ore deposit has been discovered at the uranium rich Rum Jungle in Australia's northern territory. Drilling during the last 18 months has shown that the quantity of ore was comparable to Rum Jungle itself.

Noranda Mines, Vancouver has reportedly signed a $6-million, seven year contract with eight Japanese steel manufacturers for 700,000 tons of British Colombia ore at $8.80 a ton. The contract, officially announced in Tokyo but not yet confirmed in Vancouver, will be the sixth contract for shipment of British Columbia iron ore to Japan.

WASHINGTON IMPACT

Highlights

THERE ARE INCREASING SIGNS in Washington that the new Democratic Administration's plans to better the situation of domestic metal-mineral producers will be tied closely—more closely than in the past—to the over-all foreign trade policy President Kennedy intends to pursue.

Kennedy is leaning toward an increasingly liberalized trade policy—almost all of the advice he is getting lies in that direction.

His advisors are urging him to avoid parochial solutions to the plights of individual industries and businesses; they argue that these economic trouble spots should be worked out within the framework of national goals, that the nation as a whole should foot the bills for helping injured domestic areas if the overriding national policy is responsible for those plights.

TWO TYPES OF DOMESTIC ASSISTANCE are getting the most attention. First, the so-called depressed areas program: it is geared more to geographical areas and the welfare of local populations than to particular industries. But the program would provide, indirectly at least, assistance to industries which are in the doldrums, whether the cause be import competition, technological change, or some other factors.

Sen. Paul Douglas (D-Ill.), is the leading Congressional advocate of depressed-area legislation. Douglas, at Kennedy's request, headed a task force which studied the problem; Douglas then introduced much of his study in the form of a legislative proposal, designated in the Senate as S-1. The number is not a precise guide to the bill's place on the Kennedy priority list, but the legislation is one of the new President's four or five major goals in this session of Congress.

Much of the Douglas' program is geared to luring new industries into a depressed area. Government loans would be made available, expert technological aid given.

But there are some aspects of the proposed program which would prove beneficial to metals and minerals, if enacted. Douglas, for example, found that in some areas higher quality minerals have been exhausted, while elsewhere they are being neglected because methods have not been developed to extract and process economically certain low-quality ores.

Douglas wants a speed-up and general expansion of the minerals research program being conducted by the Bureau of Mines.

Kennedy has pledged full support to the Douglas measure.

KENNEDY IS GIVING SERIOUS STUDY to a plan of "adjustment assistance" to U.S. industries which suffer from the nation's trade policy.

He is looking particularly at a staff study given him by Sen. Warren Magnuson (D-Wash.), chairman of the Senate Interstate and Foreign Commerce Committee.

The Magnuson study finds that some remedy other than import restrictions must be found to assist a domestic industry injured by foreign competition. If the national interest argues against such a restriction, the Government would aid the injured industry by the adjustment assistance program. The program is not detailed in the report, but presumbly would include Governmental aid to industries in the form of loans, fast tax writeoffs, higher depreciation allowances for plant and equipment, and a system of relocation and retraining grants for displaced workers.

Peril point and escape clause procedures now used by the U.S. Tariff Commission would be modified. Instead, the Tariff Commission would act as an economic board of appeals to investigate cases where injured industries claim the adjustment program fails to give sufficient help.

Restriction on imports would be the last remedy made available, even in cases where defense essentiality is argued.

The report also proposes greater willingness by the U.S. to negotiate toward international commodity agreements (such as the International Tin Agreement, to which the U.S. is not a signatory nation). Previously, there has been almost categorical opposition within the Government to any single commodity agreement.

Udall Sees No Change In Mineral Imports System

SECRETARY OF INTERIOR STEWART UDALL has quickly become the Kennedy Administration's spokesman on metal and mineral problems. Udall was one of the first Cabinet members to hold a press conference and lost no time in indicating, first, that the new Administration probably will not take any action to counter the present quota system for imports of lead and zinc and, secondly, that he doesn't think legislation now pending in Congress is sufficiently broad to be of long-term assistance to the domestic metals and minerals industry.

Udall singles out the small-producer subsidy bill for lead and zinc. Although Kennedy said during the campaign he would have signed the bill which former President Eisenhower vetoed, Udall now finds the legislation too tailored for White House approval. He cites the need for a broad minerals study and, subsequently, a minerals program. His remarks are being interpreted in some quarters as an effort to get Kennedy off the hook.

Congress' Protectionism May Stir Import Battle

WHILE THE ADMINISTRATION tends to move toward a liberalized foreign trade policy, there is no sign that Congress is in step. The indications are, rather, that the tide of protectionism which has risen annually in both the House and Senate may be reaching a new peak.

What the tide may wash to shore for the metals-minerals section of the economy is problematical at this point, but domestic industries generally are encouraged by the increasing temper against imports competition.

A number of labor unions are showing marked interest in the protectionist side of a trade battle which is beginning to take shape in Congress but will not be completely joined until 1962. That's when the present Reciprocal Trade Agreements Act expires, and the Kennedy plans for a future trade program will be made specific.

The nation-wide Committee on Import-Export Policy, a group pledged to restrict foreign imports and headed by longtime protectionist O. R. Strackbein, met recently in Washington and hailed a turnout of labor observers. In the past, the Strackbein group—which is closely allied with the hard core of free-trade critics in Congress—has had little support from unions. At the latest meeting, however, about a dozen representatives from unions new to the protectionist side came to observe the trade-restriction movement.

Although the labor spokesmen did not commit themselves, Strackbein's group foresees the emergence of a new ally.

Bailey Pushes New Bill To Freeze Trade Policy

REP. CLEVELAND M. BAILEY (D-W. Va.) is lining up support in Congress to tie the hands of U.S. negotiators at the upcoming Geneva session of the General Agreement for Tariffs and Trade (GATT).

Bailey is pushing a bill which would freeze U.S. trade policy where it now stands, bar any international tariff concessions or other changes until a new trade policy is thrashed out in Congress next year. He recently had lined up about 40 co-sponsors and is looking for 100. With that number, he hopes to get a hearing before the House Ways and Means Committee.

Congressional observers don't give Bailey much chance of success in halting the GATT negotiations, mainly because a new President normally gets most of what he wants from Congress during the first year and Kennedy will want the Geneva meeting on schedule.

But observers feel that if Bailey's bill gets any support, it will demonstrate the rising protectionist mood.

R. F. Kennedy Eyes Pricing

ATTORNEY GENERAL ROBERT F. KENNEDY is saying privately that his greatest interest in the antitrust area is pricing, particularly where he thinks pricing practices tend to keep U.S. industries behind competition in the world market. Kennedy and his antitrust chief may try to develop a record on prices much as the GOP administration did on merger cases. The Republican campaign against mergers continued almost until the day before the Kennedy Administration took office. In the last days of the GOP term, the antitrust chief Robert Bicks took action to upset Asarco's stock acquisition of General Cable Corp. and Revere Copper and Brass Co.

OAS May Isolate Cuba

THE KENNEDY ADMINISTRATION sees little chance for any early resumption of diplomatic relations with Cuba.

With Castro holding valuable U.S. mining properties, the next move by the U.S. may be to go before the Organization of American States and seek isolation of Castro's Cuba from the remainder of the Western Hemisphere.

The OAS action, as proposed by some diplomats, would include total economic and diplomatic embargoes on Cuba, a sea-air alert to prevent the shipment of Cuban arms to other Latin nations, and a special organization to watch the activities of Cuban, Chinese, and Soviet agents in Central and South America.

Labor This Month

MINE-MILL'S FIGHT-FOR-SURVIVAL: Threatened with new mine closings and heavy layoffs in an industry already hit by unemployment and shorter workweeks, leaders of the Mine-Mill and Smelter Workers appealed to the Kennedy Administration for quick action. Their past economic battles with the nonferrous industry forgotten, the union officials joined with management "to preserve the U.S. nonferrous metals industry against danger of collapse."

In separate action, the union—noting scheduled layoffs this month of more than 1200 Kennecott Corp. employees—asked President Kennedy and the Congress to find immediate legislative remedies. Besides specific new tariff protection for the industry, the union urges prompt relief for unemployed workers in the form of higher unemployment compensation and aid to distressed areas.

Joining industry officials in an unusual joint tour of Kennecott installations in Nevada, union teams previewed plans to boost the nonferrous industry's competitive status—through stepped-up automation, and further reduction of the work force. Union officers glumly concede the necessity of both steps, though it's hoped that new job losses can be handled mostly by attrition.

Mine-Mill's immediate stop-gap action is an 8.5 cent wage boost negotiated locally with Anaconda and Phelps-Dodge—also expected to be sought from Kennecott. This, however, may signify an important change in nonferrous collective bargaining. Industry and union, joined in a survival program, may find a working formula for improvements in contracts and operating methods at the same time.

INDUSTRY-WIDE STRIKES—A NEW LOOK: Some surprising revelations, and conclusions on the effect of major strikes come from U.S. Labor Department study on post-war steel strikes. Say the authors: "it is our opinion that the economic impact of strikes on the economy are usually seriously exaggerated." The report covers five major post-war strikes in the steel industry, and reaches three conclusions: that, despite their length (average, 56 days) the strikes did no permanent damage to the economy; that they had little effect on wages and prices in other industries; that the strikes "do not warrant the public consternation and outcry that have occurred in the past."

The report takes exception to President Kennedy's proposals for handling industry-wide walkouts. The new Administration intends to ask Congress for an "arsenal of weapons" to deal with such strikes to add to the Taft-Hartley Act's national emergency injunction—ranging from seizure to White House recommendations for settlement. According to the steel report, Government intervention in steel strikes in the past has only delayed settlement. It suggests keeping hands off.

LABOR IMPORT BOYCOTT LOOMS: Organized labor is shifting from its traditional free trade role in the face of heavy foreign imports. Needle trade unions already have sought curbs on imports of Japanese and Hong Kong materials. Now the key manufacturing unions are beginning to strike out against handling Japanese products in an effort to save jobs. In Chicago, a local of the International Brotherhood of Electrical Workers has advised employers its members will not handle Japanese electronic parts after May 1. Local 301 blames the loss of half its membership—now 23,000—on the import of equipment from Japan.

In Long Beach, Cal., the International Association of Machinists has lodged a formal protest against Rohr Aircraft Co. for importing tools and dies from Japan. IAM lodge 755 appeals to Congress to halt such imports in its area which is already on the distressed area listings. So far, IAM members say nothing about using the tools and dies in manufacturing equipment—and Rohr Aircrafts says it imported the equipment only for testing purposes; that they will not be used in the manufacturing of defense products.

So far, AFL-CIO headquarters policy continues in favor of free trade. However, with more unions demanding import curbs, the union high-command will make a major review of the whole situation when the AFL-CIO Executive Council meets later this month.

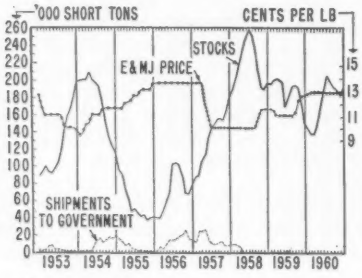
MARKETS

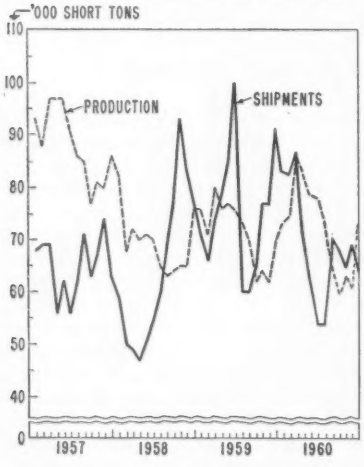
Copper Price Cut 1c; Zinc also Down; Lead-Zinc Support Bill Introduced

THE E&MJ INDEX of nonferrous metal prices in January dropped from 118.7% of the 1947-49 average in December to 116.1%. Copper prices declined more than ½c during the month; zinc nearly 1c; and lead approximately .4c. The January figure was lower than any month of 1960. The index one year ago was 127.8% with copper above 33c, zinc nearly 13c and lead at 12c.

The pricing of domestic zinc by U.S. producers and smelters snagged early in the month when St. Joseph Lead Co. commenced selling at the E&MJ average less a ½c discount on January 1. The action was aimed at putting an end to alleged discounts by U.S. sellers. Discounts of various sorts were later substantiated.

The St. Joe pricing policy confused the market to the extent that no one was quite certain just what the price was. E&MJ, on the advice of a majority of its informants, quoted a 12c nominal price, the last acceptable daily weighted average. The monthly average excluded nominal quotations.





The above data, except price, are from the American Zinc Institute and are in thousands of short tons. They refer to slab zinc of all regularly operating United States primary and secondary smelters. Data include December.

On January 9, Asarco cut its official price ½c to 11½c a lb East St. Louis, the then theoretical market, explaining that it desired to revert to the previous industry policy of selling without discounts. Other sellers followed expressing hope that the market would return to order.

St. Joe rescinded its sales policy beginning January 12, "in view of the announced intention of the zinc-producing industry to revert to the long-established practice of selling at quoted prices without discounts and in the interest of orderly marketing."

Settlement of strikes at N.J. Zinc Co. and Bunker Hill with the resultant returned capacity of about 17,000 tpm had markedly weakened the already soft market. The month closed at a fairly stable price of 11½c a lb. Price confusion limited sales early in January, but the month closed briskly with somewhat improved activity.

A new American Bureau of Metal Statistics series showed world stocks of zinc down about 15,000 tons in November to 296,489 tons.

A bill that would provide a subsidy for small miners of lead and zinc based on a 16c price for each metal; a tariff of 2c for each metal; 1.4c tariff for each ore; and a removable tax of the same amount on both metals if the price goes below 13½c has been introduced in the House by Rep. Wayne Aspinall (D-Colo.), chairman of the Interior Committee. The bill would include provision for a compensatory tax of 2c a lb on lead and zinc content of imported manufactured products above current levies.

Lead sales in January exceeded 45,000 tons and were the best since May 1960. The price of 11c a lb N.Y. was steady to firm. End-year figures indicated that 1960 domestic stocks were 160,000 tons, 40,000 higher than last December.

Copper, which began the year at 30c a lb delivered, was cut to 29c by a custom smelter early in the month. A cut had been rumored and was not unexpected when the spread between the U.S. and London prices reached about 3c. One week later, despite rumors to the contrary, producers cut their price in the U.S. 1c to 29c delivered with Kennecott Copper taking the lead. January ended with all sellers but dealers at 29c. Dealers sold fair amounts at 28½c during the month.

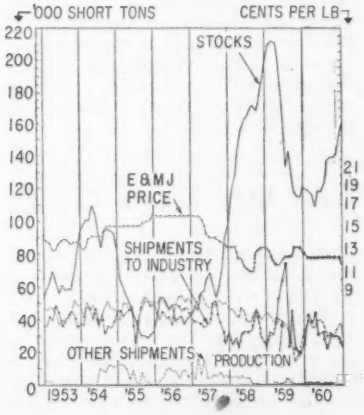
The cut in U.S. copper prices stimulated a surge of production curtailments. Anaconda sliced 10% in both Chile and the U.S.; Kennecott cut its domestic output only by 13%; Southern Peru Copper Corp. was operating at 15% of second-half 1960; White Pine was down 20%; Inspiration Copper 10%; and Cerro 10% joining just about every other Free World producer in limiting supply.

Diversion of a strike at Kennecott's El Teniente Mine in Chile after a one-week postponement to an extent shook the confidence of the London market. Prices moved off with announcement. A 15-month contract was signed with workers gaining a 15% increase and assorted fringe benefits.

Sen. Mike Mansfield surprised the copper world with a suggestion that the U.S. copper industry consider a world cartel to correct depressed copper prices. Initially copper men were unenthused. Price control and government intervention are alien to U.S. business tradition.

U.S. primary aluminum production rose slightly in December to 165,504 tons, but the percent of operation capacity dipped to 78.9% from 70.5% owing to the extra work day. Output for the year was 2,014,499 tons, a record high. Primary stocks took a mighty jump in October to 248,000 tons and promised to exceed 260,000 tons for the year. Stocks at the beginning of 1960 were 127,532 tons.

The Tariff Commission held a one-day hearing late in the month on the advisability of negotiating tariffs at coming meeting of the General Agreement on Tariffs and Trade in Geneva. Domestic producers held that no imports are needed for defense because of stockpiles; no imports are required by fabricators because of the heavy supply; and that there is substantial U.S. idle capacity. Aluminum Ltd. (Canada) argued for a maximum reduction on ingot saying imports have had no injurious effect on the domestic industry.



The above data, in thousands of short tons, are from the American Buretau of Metal Statistics. They refer to the total amounts of refined lead as reported by all primary refiners in the U.S. Some secondary lead is included. It is assumed "other shipments" refers to lead sent to the U.S. Government "Shipments to industry" includes exports. Data are through December.

Average Prices January (E&MJ Quotations)

Cents per lb unless otherwise indicated:	
Copper:	
Electro, domestic refinery	29.057
Electrolytic, exports refinery	26.746
Electrolytic, c.i.f. Cont'l ports	27.691
Lead:	
Common, New York	11.000
Common, St. Louis	10.800
Silver:	
Silver, New York, per oz	91.375
Silver, London, pence per oz	79.446
Zinc:	
Prime, Western, East St. Louis	**11.529**
Prmie, Western, delivered (g)	**12.029**
Tin:	
New York Straits	100.408
Gold, per oz, U.S. price	$35.000
Sterling, Exchange	280.641
Quicksilver, per flask	$209.000
Antimony, (E&MJ) (d)	32.590
Antimony, bulk, Laredo	29.000
Antimony, in cases, Laredo	29.500
Antimony for. 99% (h)	25.006
Palladium, troy oz	$24.000
Platinum, refined, per oz	82.000
Cadmium (a)	150.000
Cadmium (b)	160.000
Al, 99½% unalloyed ingot	26.000
export, ingot	23.250
Magnesium, ingot	35.250
Nickel, (f)	74.000
Bismuth	$2.250
Cobalt	$1.500

Domestic quotations, unless otherwise stated are in cents per lb. Sterling exchange checks, in cents. Quick-silver per flask of 76 lb.
(a) Per lb delivered, ton lots.
(b) Per lb delivered, small lots.
(d) Domestic 5 tons or more but less than carload lots, packed in case f.o.b. New York.
(f) Contract price, f.o.b. Port Colborne U.S. duty included.
(g) Delivered where freight exceeds 0.5c.
(h) 2c duty extra.

Free Gold Markets

International gold trading volume rose 8% during January. Bar prices were fractionally higher, while coin prices increased from 1% in Europe to 8% in Bombay. On January 14 a Presidential Decree prohibited American citizens from buying or hoarding gold in any form abroad. Present holdings must be liquidated by May 31. U.S. gold losses amounted to approximately $360-million since the end of the year reducing the stock to about $17.42-billion. Pick's World Currency Report quotes on "free gold" per fine oz as follows:

	Coins		Bars (12.5 kg)	
	Dec. 31	Jan. 31	Dec. 31	Jan. 31
New York transit	.....	.....	$35.60	$35.50
Manila	$41.65	$41.85	37.00	37.10
Hong Kong	48.70	48.25	41.00	41.15
Bombay	54.25	58.75	51.50	57.50
Beirut	41.35	41.35	35.78	35.79
Paris	41.70	42.50	36.25	36.10
Buenos Aires	42.15	42.30	37.50	36.50

Note: Prices are quoted at the free or black market value of the U. S. dollar in the local markets.

Custom Smelter Copper

Based on flat price and E&MJ average price sales in U.S. for month of January reported by American Smelting & Refining Co. electrolytic copper in standard shapes, adjusted to nearest ⅛c; ¼c deducted for selling common.

Delivered consumer's plant	29.125 lb
F. o. b. refinery	28.725 lb

Major Metals

U.S. DAILY AND AVERAGE PRICES

Cents per lb unless otherwise indicated:

Jan. 1961	Electrolytic Copper (a) Domestic	(b) Export	Europe c.i.f. (e)	Lead New York	Lead St. Louis	Zinc (f) Delivered	Zinc East St. Louis	Aluminum Ingot 99% U. S. Dest.	Straits Tin New York
2					Holiday				
3	29.600	27.600	28.545	11.000	10.800	12.500	12.000	26.000	100.625
4	29.600	27.425	28.370	11.000	10.800	12.500*	12.000*	26.000	100.500
5	29.500	27.275	28.220	11.000	10.800	12.500*	12.000*	26.000	100.500
6	29.525	27.225	28.170	11.000	10.800	12.500*	12.000*	26.000	100.500
9	29.575	27.200	28.145	11.000	10.800	12.500*	12.000*	26.000	100.325
10	29.600	26.500	27.445	11.000	10.800	12.000	11.500	26.000	100.250
11	29.525	26.375	27.320	11.000	10.800	12.000	11.500	26.000	100.125
12	29.600	26.450	27.395	11.000	10.800	12.000	11.500	26.000	100.125
13	29.575	26.425	27.370	11.000	10.800	12.000	11.500	26.000	100.250
16	29.500	26.450	27.395	11.000	10.800	12.000	11.500	26.000	100.250
17	28.600	26.300	27.245	11.000	10.800	12.000	11.500	26.000	100.375
18	28.600	26.450	27.395	11.000	10.800	12.000	11.500	26.000	100.750
19	28.600	26.725	27.670	11.000	10.800	12.000	11.500	26.000	100.875
20	28.600	26.900	27.845	11.000	10.800	12.000	11.500	26.000	100.500
23	28.600	26.700	27.645	11.000	10.800	12.000	11.500	26.000	100.375
24	28.600	26.900	27.845	11.000	10.800	12.000	11.500	26.000	100.375
25	28.600	26.700	27.645	11.000	10.800	12.000	11.500	26.000	100.375
26	28.600	26.450	27.395	11.000	10.800	12.000	11.500	26.000	100.375
27	28.600	26.475	27.420	11.000	10.800	12.000	11.500	26.000	100.625
30	28.600	26.550	27.495	11.000	10.800	12.000	11.500	26.000	100.250
31	28.600	26.600	26.945	11.000	10.800	12.000	11.500	26.000	100.250
AVERAGES FOR MONTH									
Jan.	29.057	26.746	27.691	11.000	10.800	12.029	11.529	26.000	100.408
AVERAGES FOR WEEK									
Jan.									
4	29.600	27.606	28.326	11.000	10.800	12.500	12.000	26.000	100.406
11	29.545	26.915	27.860	11.000	10.800	12.300	11.800	26.000	100.340
18	29.175	26.415	27.360	11.000	10.800	12.000	11.500	26.000	100.350
25	28.600	26.785	27.730	11.000	10.800	12.000	11.500	26.000	100.500
CALENDAR WEEK AVERAGES									
Jan.									
6	29.556	27.381	28.326	11.000	10.800	12.500	12.000	26.000	100.531
13	29.575	26.590	27.535	11.000	10.800	12.100	11.600	26.000	100.215
20	28.780	26.565	27.510	11.000	10.800	12.000	11.500	26.000	100.550
27	28.600	26.645	27.590	11.000	10.800	12.000	11.500	26.000	100.425

(*)-nominal

Silver, Gold and Sterling

DAILY AND AVERAGE PRICES

Jan. 1961	Silver (c) New York	Silver London	Sterling Exchange	Gold (d) London
2		Holiday		
3	91.375	79.375d.	280.6380	253s. 9d.
4	91.375	79.375d.	280.6260	254s. 2d.
5	91.375	79.375d.	280.6380	254s. 3d.
6	91.375	79.375d.	280.6520	254s. 3d.
9	91.375	79.375d.	280.7080	254s. 5d.
10	91.375	79.375d.	280.6760	254s. 5d.
11	91.375	79.375d.	280.6500	254s. 7d.
12	91.375	79.375d.	280.7120	254s. 11d.
13	91.375	79.375d.	280.6760	254s. 10d.
16	91.375	79.375d.	280.5940	252s. 6d.
17	91.375	79.375d.	280.6760	253s. 1d.
18	91.375	79.375d.	280.7500	252s. 11d.
19	91.375	79.375d.	280.7340	252s. 7d.
20	91.375	79.375d.	280.7040	252s. 8d.
23	91.375	79.375d.	280.6060	252s. 11d.
24	91.375	79.625d.	280.6400	252s. 10d.
25	91.375	79.625d.	280.6680	252s. 6d.
26	91.375	79.625d.	280.6580	252s. 5d.
27	91.375	79.625d.	280.6280	252s. 5d.
30	91.375	79.625d.	280.4400	252s. 8d.
31	91.375	79.625d.	280.3860	252s. 4d.
AVERAGES FOR MONTH				
Jan.	91.375	79.446d.	280.641	—
AVERAGES FOR WEEK				
Jan.				
4	91.375	79.375d.	280.498	—
11	91.375	79.375d.	280.665	—
18	91.375	79.375d.	280.682	—
25	91.375	79.475d.	280.670	—

Calendar Week Averages: New York Silver: Jan. 6 91,375; Jan. 13, 91.375; Jan. 20, 91,375; Jan. 27 91.375.
(e) No Market (Saturday).

THE above quotations for major nonferrous metals are our appraisal of the important United States markets, based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis. All prices, except gold and silver, are in cents per pound.

(a) Net prices at refineries on Atlantic seaboard. To arrive at the delivered U.S. basis add 0.400c per pound, the average differential for delivery charges.

(b) Export copper daily quotations are weighted averages based on sales outside the U.S. reported to E&MJ. Ocean freight and 0.125c lighterage and handling are deducted to arrive at the f.o.b. Atlantic seaboard refinery quotation. On f.a.s. U.S. sales lighterage of 0.125c is deducted.

(c) The daily silver quotations reported by Handy & Harman, in cents and fractions of a cent per troy ounce, is the price paid by Handy & Harman in settlement for silver contained in unrefined silver-bearing materials submitted to them for refining. It is determined on the basis of offers of bar silver .999 fine as made to Handy & Harman for nearby delivery at New York by regular suppliers in quantities sufficient to meet daily requirements, and it is usually 0.250c below the price at which such offers are made.

The Treasury's purchase price of newly mined domestic silver is 90.5c per troy ounce 1000 fine effective July 1, 1946. London silver in pence per troy ounce, basis .999 fine.

(d) U. S. Treasury's gold price is $35. Actual payment by the United States Treasury for gold is at 99.75 per cent of the price quoted by the Treasury, which is equal to $34.9125.

(e) The c.i.f. Continental ports quotation is arrived at by adding to the f.o.b. export quotation lighterage, and the standard conference freight and insurance, Atlantic ports to main Continental ports. Currently this is 0.125c and 0.82c.

Copper, lead and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

Quotations for copper are for the ordinary forms of wirebars and ingots; cathodes are sold at a discount of 0.125c to 0.15c per pound. Quotations for zinc are based on Prime Western brands. Zinc in New York commands a premium over the St. Louis basis equal to the freight differential. Contract prices for High Grade zinc delivered in the East, Middle West and West effective Apr. 1, 1960, commanded a premium of 1.50c per pound over the current market for Prime Western; Special High Grade 1.75c effective Apr. 1, 1960.

(f) Prime Western delivered where freight from E. St. Louis exceeds 0.500c.

Quotations for lead are based on domestic common lead. Corroding lead commands a premium of 10c points (almost all U.S. lead is corroding grade).

MARKETS *(Continued)*

London Metal Exchange Quotations

Jan. 1961	Copper — Cash Bid	Copper — Cash Asked	Copper — 3 Mon. Bid	Copper — 3 Mon. Asked	Lead — Current Month Bid	Lead — Current Month Asked	Lead — 3 Mon. Bid	Lead — 3 Mon. Asked	Zinc — Current Month Bid	Zinc — Current Month Asked	Zinc — 3 Mon. Bid	Zinc — 3 Mon. Asked	Tin — Cash Bid	Tin — Cash Asked	Tin — 3 Mon. Bid	Tin — 3 Mon. Asked
2	Holiday															
3	226¼	226½	225½	225¾	63⅝	63⅞	64⅜	64½	80¼	80½	78¾	79	789½	790	790	790½
4	224½	224¾	224¼	224½	62¾	63	63¾	64	80¾	80½	78½	78⅝	788	788½	788½	789
5	223½	223¾	224¼	224½	63¼	63⅜	64¼	64⅜	80	80¼	78⅜	78½	788	788½	789	789½
6	223½	223¾	224¼	224½	64	64¼	65	65¼	81⅛	81⅜	78⅞	79	788	788½	789½	790
9	222½	222¾	223	223¼	63¾	64	65	65⅛	80¼	80½	78¾	79	786	786½	788	788½
10	216¾	217	217½	217¾	63¼	63½	64½	64⅝	78⅝	78½	76¾	76⅜	783	783½	785	786
11	218¼	218½	219¼	219½	63¼	63⅜	64½	64⅝	77⅝	78	76¾	77	781½	782	784	784½
12	216½	216¾	217¾	218	63⅜	63¾	65	65⅛	77⅝	77¾	76¾	77	779½	780	779	780
13	217½	217¾	219	219¼	64¼	64½	65½	65⅝	78⅜	79⅛	77¾	78	779½	780	784	785
16	217½	217¾	218¾	219	64⅛	64¼	65½	65⅝	79½	79¾	78½	78⅝	779	779½	783	784
17	216¼	216½	217½	217⅝	64⅛	64¼	65⅝	65½	79½	79⅝	78½	78⅝	780	781	783½	784½
18	221¼	221¾	221¼	221½	64½	64¾	65⅝	65⅞	79½	79¾	79	79½	784	784½	787½	788
19	222¾	223	222¾	223	64½	64⅝	65⅝	65⅞	78⅝	78¾	78½	78⅝	784	784½	787½	788
20	219½	219¾	220¼	220½	64	64⅛	65¼	65⅜	79	79¼	78⅜	78¾	781½	782	785½	786
23	220½	220¾	220⅜	221	63½	63⅝	64⅝	64⅞	78¼	78½	78¼	78½	780½	781	784	784½
24	219¾	220	220¼	220½	63½	63⅝	64¾	64⅞	78½	78⅝	78¼	78⅝	780	781	784	785
25	218¾	219	219¼	219½	63¼	63½	64⅝	64¾	78⅝	78¾	78½	78¾	781	781½	784½	785
26	217	217¼	217½	217¾	63¼	63⅜	64½	64⅝	78⅝	78¾	78⅜	78½	783½	784	786½	787
27	217¾	218	218¼	218½	63⅝	63¾	64¾	64⅞	79	79½	78⅞	79	786	787	789	789½
30	218¼	218½	219	219¼	63¾	63⅞	65	65⅛	79	79¼	79	79½	784	784½	787½	788
31	219¼	219¾	220½	220¾	64	64¼	65⅛	65¼	79½	79⅝	79⅛	79½	783½	784	787	787½
Av'g's	£220.030		£220.637		£63.798		£64.976		£79.235		£78.405		£783.619		£786.345	

Prices are for the official a.m. session in pounds sterling per ton of 2240 lb. Copper basis wire bars, lead 99.0%, zinc 98% and tin min. 99.7%5.

Miscellaneous Metals, Ores, Minerals

Quotations cover wholesale lots, prompt shipments, f.o.b. New York unless otherwise stated, tons of 2,000 lb unless otherwise noted. st—short ton; lt—long ton; stu—short ton unit; ltu—long ton unit. (p) duty extra.

MISCELLANEOUS METALS

Jan. 31, 1961

Aluminum ingot, 99.9% lb		28c
Antimony, spot, lb. less than carload, in cases		32.59c
In bulk, carload lots, f.o.b. Laredo		29.00c
Imported, 10 ton min. (p), 99% Duty not paid	25c —	25.25c
Bismuth, ton lots, lb		$2.25
Cadmium, ton lots delivered, lb		$1.50
small lots		$1.60
Calcium, lb, ton lots, 98%, cast		$2.05
Chromium, 99.8% grade, lb, contract delivered	$1.15 —	$1.19
Cobalt, 97 to 99%, per lb effective 3-1-60		$1.50
Germanium, per gram, 10,000 gram lots	(d)28.15c—(c)(d)	29.95c
Indium, troy oz	$1.35 —	$2.25
Lithium, lb, 98%	$9.00 —	$11.00
Nickel, cathodes, lb (a)		74c
Other sales, regular sellers		74c
Sales by dealers, etc		74c
Magnesium, 99.8% carloads, lb producer's plants, Velasco, Texas, effective Apr 16		35¼
Palladium, troy oz	$24 —	$26
Platinum, troy oz	$81 —	$85
Quicksilver, flask of 76 lb, 25 flasks or more	$209 —	$212
Selenium, 99 plus %, lb—(Feb. 19, 1958)	$6.50 —	$7.50
Silicon, minimum 98%, carloads, lb		19c
Semi Conductor grade, lb., lump		$360
Tellurium, lb		$4.00
Thallium, 100 lb or more		$7.50
Titanium, 99.3% plus, grade A-1, max. 3% Fe, lb (b)	$1.50 —	$1.60

(a) Effective Dec. 6, 1956; including U. S. duty; (b) Effective Aug. 1, 1959. (c) Delivered; (d) f.o.b. plant.

METALLIC ORES

Beryllium ore, imported, 10% BeO, (b) stu; spot	$32 —	$33
term contracts	$34 —	$34.50
Chrome ore per long ton, f.o.b. cars Atlantic ports, dry: 44% Cr_2O_3 no ratio	(a)$19.75 —	$20.50
48% Cr_2O_3 3 to 1 ratio	$35¾ —	$38
Iron ore, Lake Superior, Lower Lake ports, lt		
Old Range bessemer		$11.85(e)
Mesabi bessemer		$11.60(e)
Mesabi non bessemer		$11.45(e)
Lead (Galena), 80%, Joplin, Mo., ton		$125.16
Manganese ore—Per ltu of Mn basis 48%, nearby positions, subject to premiums and penalties, c.i.f. U. S. ports import duty extra., (n)87c—90c. Long-term contract nominal.		
Molybdenum ore, 90%, per lb of Mo f.o.b. mines		$1.25
Columbium-Tantalum, per lb, combined oxides 10 to 1 ratio	$1.18 —	$1.25
Tungsten ore, per stu of WO_3:		
Foreign 60%, c.i.f. U. S. ports, duty extra	$17.75 —	$18.25
U. S. scheelite, f.o.b. mill	$22 —	$24
Vanadium ore, per lb of contained V_2O_5 f.o.b. mines		31½
Zinc ore, Prime, 60% concentrate, Joplin, Mo., per ton		$68

(a) Nominal. (b) c.i.f. U. S. ports.
(e) Effective 1958 shipping season.

METALLIC COMPOUNDS

Arsenous oxide (arsenic trioxide) lb, in bbl, carload lots N. Y. docks		4–5c
Cobalt oxide, 72½% to 73½%, per lb, effective Mar. 1, 1960	$1.15 —	$1.18
Copper sulphate, 100 lb, effective 10-12-60		$12.00
Germanium dioxide, gm		16¾c
Molybdic trioxide, technical, per lb of Mo	$1.46 —	$1.47
Imported, including 37c duty	$1.75 —	$2.05

ALLOYS

Ferrochrome 65 to 70%, per lb of Cr, (4-9% C)		28¾c
Ferromanganese, 74 to 76%, per lb shipping point		11c
Ferromolybdenum, 58 to 64% Mo, lb of Mo contained	$1.50 —	$1.82
Ferrosilicon, 50% per lb of Si f.o.b. shipping point (3-1957)		14.60c
Ferrotungsten, 72 to 82%, lb of W contained		$2.25
Ferrovanadium, per lb of V delivered	$3.20 —	$3.40
Silicomanganese, max., 1½% C, lb contracts		11.6c
Spiegeleisen, per lt, 19–21% grade effective Jan 22	$100.00 —	$102.50

NONMETALLIC MINERALS

Asbestos, f.o.b. Canada (Quebec) mines (Canadian funds) ton:			
Crude No. 1	$1,400–$1,725	Paper stock	$120–$142
Crude No. 2	$750–$1,100	Waste	$75– $86
Spinning Fibers	$370– $600	Shorts	$40– $75
Shingle fibers	$180– $220		
Asbestos, f.o.b., Vancouver, B. C. (Canadian funds):			
Crude No. 1	$1,522	Spinning fibers	$220–$787
Asbestos, Vermont, f.o.b. Morrisville:			
Spinning fibers	$353– $408	Waste, stucco or plaster	$86
Shingle stock	$181– $218		
Paper stock	$120– $142	Refuse or shorts	$41– $75
Barytes, f.o.b. cars:			
Georgia, crude, per ton			$18
Missouri, 94%, $BaSO_4$, per st	$16 —		$18
Crude oil well grade, min. 4.3 sp gr, st (a)			$18
Imported, c.i.f. Gulf Ports, st	$16 —		$18
Bauxite, st, f.o.b. point of shipment:			
Imported metallurgical, per lt, f.o.b. Br. Guiana, 60% Al_2O_3, 6% SiO_2, 1.25% Fe, 1-1-60			$7.25
Feldspar, bulk ton; f.o.b. plants:			
Potash or soda feldspar, 200 mesh, ceramic grade	$17 —		$20.50
Glass feldspar, white, 20 mesh			$9
Fluorspar, f.o.b. mines, bulk, 72½% effective, ton	$37 —		$41
60% effective CaF_2	$33 —		$36
Acid 97% concentrate, bulk, ton			$45.00
Fuller's earth, f.o.b. Georgia or Florida, ton	$7.00 —		$14.00
Magnesite, per ton dead-burned, bulk, f.o.b. Washington			$46

Mica—Domestic, f.o.b. mines, Punch 7c-12c per lb according to size and quality. Sheet clear 1½x2 in. 70c-$1.10; 2x2 in $1.10 to $1.60; 2x3 in, $1.60-$2.10; 3x3 in, $1.80-$2.30; 3x4 in, $2.00-$2.60; 3x5 in, $2.60-$3.00; 4x6 in, $2.75-$4.00; 6x8 in, $4.00-$8.00. Wet ground, very fine, $140-$155 per ton. Bulk sales, dry ground; $30-$55 per ton. Scrap $20-$30.

Ocher Georgia, ton in sacks	$26.50 —	$32.00
Sulphur, Mexican, for use in Mexico, metric ton, f.o.b. mines, depending on location	$21 —	$23
For export f.o.b. vessel, depending on grade	$22.50 —	$23.50

Actual prices received by U. S. producers approximate the Mexican export prices.

Talc, f.o.b. works, ton:		
New York, purified	$18.00 —	$20.00
Vermont, extra fine		$12.50
Tripoli, Missouri, ton:		
40-mesh, cream colored		$50.00

(a) Some restricted sales at $11.50 (b) Corrected. (c) Nominal.

IRON AND STEEL

Pig iron, gross ton, basic, Valley furnaces		$66.00
Steel, f.o.b. Pittsburgh, billets, net ton		$80.00
Structural shapes, Pa., Ala., etc., 100 lb	$5.30 —	$5.50

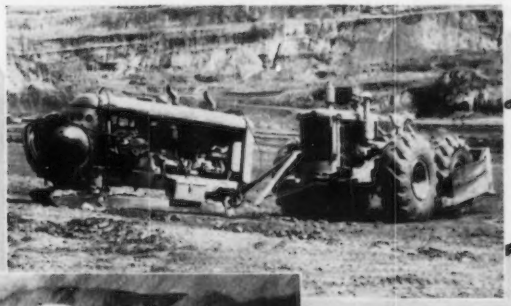
Here's how TOURNATRACTOR® puts extra savings in your pocket!

Handles more tractor jobs over a wider area . . . faster

Because of its rubber-tired speed . . . power . . . and mobility . . . Tournatractor gets around fast . . . completes widely-separated assignments at low cost. Thus, you need fewer tractors . . . and the saving is yours.

Get the full story on 218-hp Tournatractor from your LeTourneau-Westinghouse Distributor. He will be happy to arrange a demonstration so you can see the money-saving possibilities in this fast, rubber-tired, heavy-duty tractor. Remember, you now have a choice of Tournatractors . . . electric control or hydraulic blade control . . . speeds to 18.5 mph.

SKIDS EQUIPMENT



WORKS ACROSS TRACKS

Rubber-tired Tournatractor is never more than a few minutes from its next assignment . . . anywhere in your pit or plant area. This drive-anywhere mobility often permits you to eliminate 2 or more crawlers, reduce operating costs substantially.

BUILDS STOCKPILES, FEEDS HOPPER

CLEANS AROUND SHOVELS

LEVELS DUMP AREA

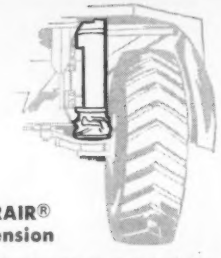
MAINTAINS ROADS, PIT FLOOR

CT-2345-MQ-1

LeTOURNEAU-WESTINGHOUSE COMPANY, PEORIA, ILLINOIS

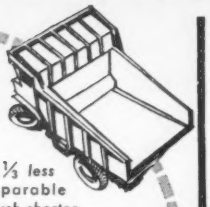
A Subsidiary of Westinghouse Air Brake Company

Where quality is a habit



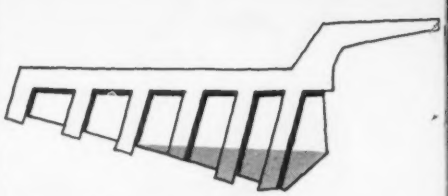
HYDRAIR® suspension

Haulpak rides on air, *not* steel. No springs, no front-axle or related maintenance. Less deadweight. High, 19 to 28-in. ground clearance, short turns. Four simple Hydrair units cushion load and road shocks, keep load riding level.



short turn-circle

Haulpak turns in ⅓ *less* space than comparable haulers, and *much shorter* than many smaller rigs. You have short wheelbase . . . and sharp-angle turn, because there's no spring or axle obstruction at front wheels.



"bonus-tonnage" V-body

Look at the extra load capacity you get within short wheelbase. Deep V-body carries up to 8 tons of material *below* normal floor-line. Center of gravity is *low*. Exhaust-heated body prevents material from sticking or freezing-in.

Is HAULPAK® different?

You bet it is!

Judge for yourself . . . compare some of these basic Haulpak "differences" against trucks you've been using:

Haulpak, for instance, is so *maneuverable, it U-turns in ⅓ less space than comparable-capacity haulers!* In fact, one owner* says: "Haulpak's short turn-around and high speeds gain us several extra truck-loads a day."

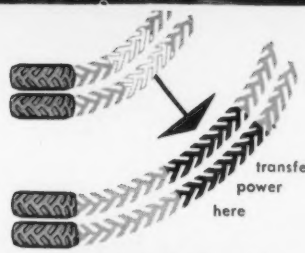
A difference in *speed?* Average top speed of the 5 Haulpak models is *32% faster than the average top speed of all other comparable-size trucks.*

A difference in *safety?* Total brake surface ranges from 3,276 sq in. on the 22-ton Haulpak to 10,186 sq in. on the 60-ton Haulpak. Compare *that* with any other hauler on the market. As another owner* puts it: "From the standpoint of safety, our Haulpaks have it all over the other trucks!"

A difference in *maintenance?* There's not a single spring to maintain on Haulpak. And *no* front axle! All parts are easy to get at; many are interchangeable. And you almost *never* have to grease Haulpak. Reports an owner*: "Haulpak has cut our truck maintenance about in half."

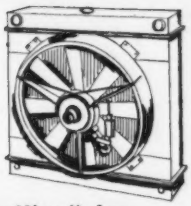
For lowest net cost per hauled ton, check the extra tons per hour, lower operating and maintenance costs *you'll* get with LW Haulpak. 5 sizes, 22 to 60 tons, up to 550 hp. More details, or a demonstration, are yours for the asking.

*Owner names on request.



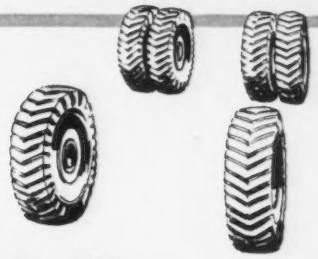
power-transfer differential

Now, for the first time on a truck, you get the LW power-transfer differential. In soft, muddy going, it automatically slows slipping wheels, transfers up to *4 times* the tractive effort to wheels on firmest footing.



"Power-Miser" fan

On the 27 to 60-ton Haulpaks, an aluminum-alloy radiator fan cools engine with *less* than half the hp-drain of conventional fans. Thermostat automatically shuts fan off when not needed, saves its horsepower for extra work-power.



interchangeable components

You operate Haulpak fleets on a *minimum* parts inventory because: All tires can be rotated to any position. Right and left wheels are readily interchanged, as well as right and left Hydrair units.

HP-2373-G-2

LE TOURNEAU-WESTINGHOUSE COMPANY

PEORIA, ILLINOIS

A Subsidiary of Westinghouse Air Brake Company

Where quality is a habit

AMSCO helps you handle more tons per dollar

SHOULD YOU BUY REPLACEMENT PARTS FROM THE COMPANY THAT BUILT YOUR CRUSHER?

Star Rock Products did, and increased their tonnage 75%

At Star Rock Products Co., Anaheim, California, crusher jaw plates previously used were giving only about 6 months' service. Large rocks often caused the jaw plates to "give" enough so the rocks wouldn't crush. Jams and costly delays resulted. Plates would often flow and crack.

Amsco and the crusher manufacturer developed a new design, using 2% chrome (Amsco MY) alloy. After 6 months' service, the plates were in excellent condition. Jams and delays have been eliminated and tonnage handled increased 75%.

Cases like this are not unusual, because it's often difficult to resist an "experiment". After one experiment, though, most producers rediscover that the "factory part" delivers the goods.

Amsco and leading crusher manufacturers work together to assure you of maximum value in parts such as hammers, rolls, jaw plates, mantles and concaves. Avoid experiments — buy maximum value through your crusher manufacturer or his dealer.

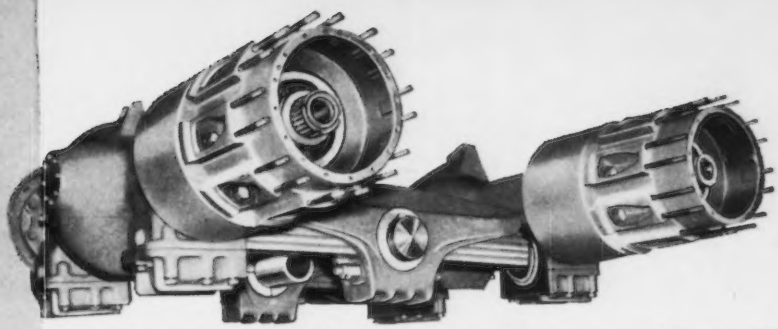
AMSCO

AMERICAN MANGANESE STEEL DIVISION • CHICAGO HEIGHTS, ILL.
OTHER PLANTS IN: Denver • Los Angeles
New Castle, Dela. • Oakland, Calif. • St. Louis

AMERICAN Brake Shoe COMPANY

NEW...MACK 45-TONNER

...for the most rigorous mining jobs



New heavy-duty off-highway bogie. Unsurpassed for ruggedness and tractive ability and adding greatly to tire life, the newly designed Mack off-highway bogie offers the strength and simplicity of straight-through drive and single-reduction carriers with Mack Planidrive® reduction in the wheel hubs. Superior ride and longer spring life are achieved by a combination of Mack's exclusive walking-beam and spring suspension. Loaded spring is in contact through full length of beam; unloaded spring falls away from beam to give extra spring length for optimum ride characteristics with body empty.

Sturdiest, most durable frame you could ask for. Built to shrug off the jarring impacts of huge shovel loads, the all-welded special alloy steel frame of the Mack M-45SX is of wide-flange I-beam construction. I-beam cross members and cross corner gussets are welded to 16¼" x 1" main frame rail web to reduce stress concentrations in the flanges.

New tubular front axle. Massive in cross section, doubly strong because of its 7" diameter tubular construction, the all-new Mack-built reversed Elliott axle withstands the heaviest loads of extra-heavy-duty mining service. Extra wide tread gives maximum stability and short turning radius.

Designed to help you haul best. Modern in design, the new, bold lines of the Mack M-45SX Model mark it as a truly functional heavy-duty dumper for the mining industry. Offset cab design means easier, safer truck handling, while forward position allows more weight to be shifted to front axle without sacrificing driver comfort.

Hard-boiled mining operators have a simple test for a truck: it either stands up to the job or it doesn't. Obviously the only practical, profitable way to tackle the toughest mining operations is to use the toughest trucks. When you've reached that conclusion, your choice boils down to one make . . . Mack!

Now there's a new Mack in the lineup. The M-45SX. This 45-ton mining-duty dumper is specifically built for the operator who has to hit the job with all he's got . . . who has to put his reputation on the most important line of all—the bottom line of a balance sheet.

The mighty Mack M Model is made for mining with mining-duty components . . . made to take in stride the toughest hauling of the industry. Successor to the highly successful 40-ton Mack Model LYSW, the new 45-ton M Model offers the proved features that won its predecessor a worldwide reputation for lowest operating costs and remarkably great freedom from downtime.

Add the new features shown on these pages and you have a vehicle destined to be first choice among users who demand the finest in heavy-duty hauling equipment. For further information about this great new off-highway unit, contact your nearest Mack branch or distributor. Mack Trucks, Inc., Plainfield, New Jersey. Mack Trucks of Canada, Ltd., Toronto, Ontario.

MACK
FIRST NAME FOR
TRUCKS

engine power
BY CATERPILLAR

How 33,000 psi cuts costs per ton

The heart of a dragline or excavator is its power source

Take the case of the Cat D397, used in the majority of large diesel powered machines. It has a horsepower rating of up to 730. Its 33,000 psi tensile strength block is precision built to provide a strong, rigid framework for all engine parts.

Here are just a few of the other features that make the D397 your best buy for excavator power. Turbocharging gives higher horsepower per pound of engine. Oil is 100% filtered to lengthen overhaul periods and engine life. Non-clogging, single-orifice injection valves let you use low-grade, low-cost fuels with cetane ratings as low as 35. These fuels have more BTU's per pound; they provide more energy per gallon.

Bearings are steel-backed aluminum alloy for high load-carrying capacity and resistance to corrosion and wear. Cat piston assemblies combine light weight in aluminum pistons, high wear resistance in chrome rings and the durability of cast iron in the top ring band. Heat treated, wet liners are full length to give rapid heat transfer, longer ring, liner and lube oil life.

If you could look inside the Cat D397 Engine you'd see additional evidence of quality in the high-strength crankshaft, in precision-ground camshaft, in the efficient cylinder heads and valve train.

Your Caterpillar Dealer is the man to see for complete facts. He'll tell you how you can save more money and make more money with Caterpillar powered excavators. Get in touch with him. It may be one of the most profitable talks you've ever had.

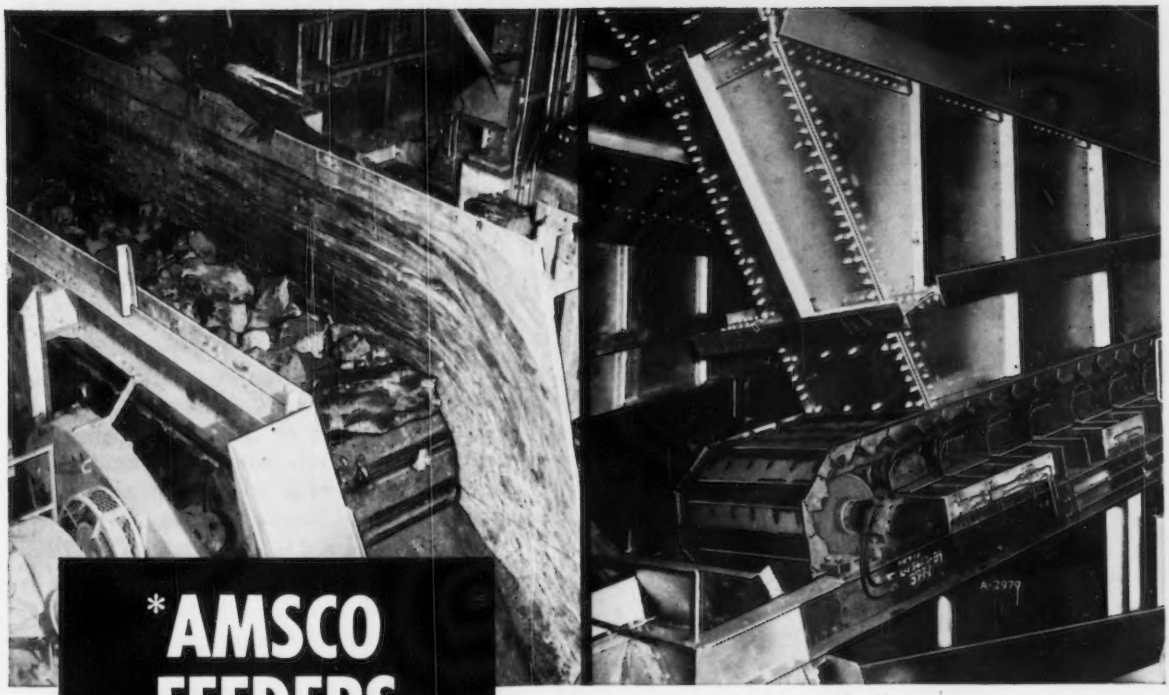
The D397's cylinder block is cast in Caterpillar's own foundry. Careful control, modern processing and rigid inspection all along the line insure a rugged foundation for all engine parts.

CATERPILLAR

Caterpillar and Cat are Registered Trademarks of Caterpillar Tractor Co.

Engine Division, Caterpillar Tractor Co., Peoria, Ill., U.S.A.

STEPHENS-ADAMSON

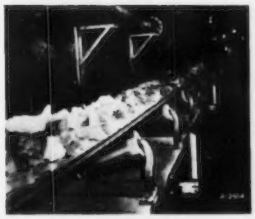


*AMSCO FEEDERS handle greater tonnages at lower cost per ton

Rugged S-A AMSCO Feeders take the impact delivered by thousands of tons of stone daily. Material flow from bins and hoppers can be accurately controlled up to 3900 T.P.H. and more. STEPHENS-ADAMSON AMSCO Feeders consist of a series of overlapping steel pans attached to endless conveyor chain. A wide range of pan styles are available depending on the application. AMSCO Feeder manganese steel pans and chain actually become tougher with continued use and impact. Many units are still in service after over thirty years of rough treatment. S-A builds a complete line of Feeders to fit every need.

*THE ROUGHER YOU TREAT 'EM . . .
THE TOUGHER THEY GET!
*Reg. T.M. American Manganese Steel Co.

S-A ENGINEERED PRODUCTS FOR STONE HANDLING SYSTEMS



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BELT CONVEYOR STACKERS—
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TUNNEL GATES—
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AMSCO FEEDERS—
REQUEST BULLETIN 255

S-A
ENGINEERED BULK HANDLING SYSTEMS
MATERIALS HANDLING PRODUCTS
SPEEDWALK® PASSENGER CONVEYORS
SEALMASTER® BALL BEARING UNITS
SPHERCO® BEARINGS & ROD ENDS

ENGINEERING DIVISION

STEPHENS-ADAMSON MFG. CO.

GENERAL OFFICE & MAIN PLANT, 4 RIDGEWAY AVENUE, AURORA, ILLINOIS

PLANTS LOCATED IN: LOS ANGELES, CALIFORNIA • CLARKSDALE, MISSISSIPPI
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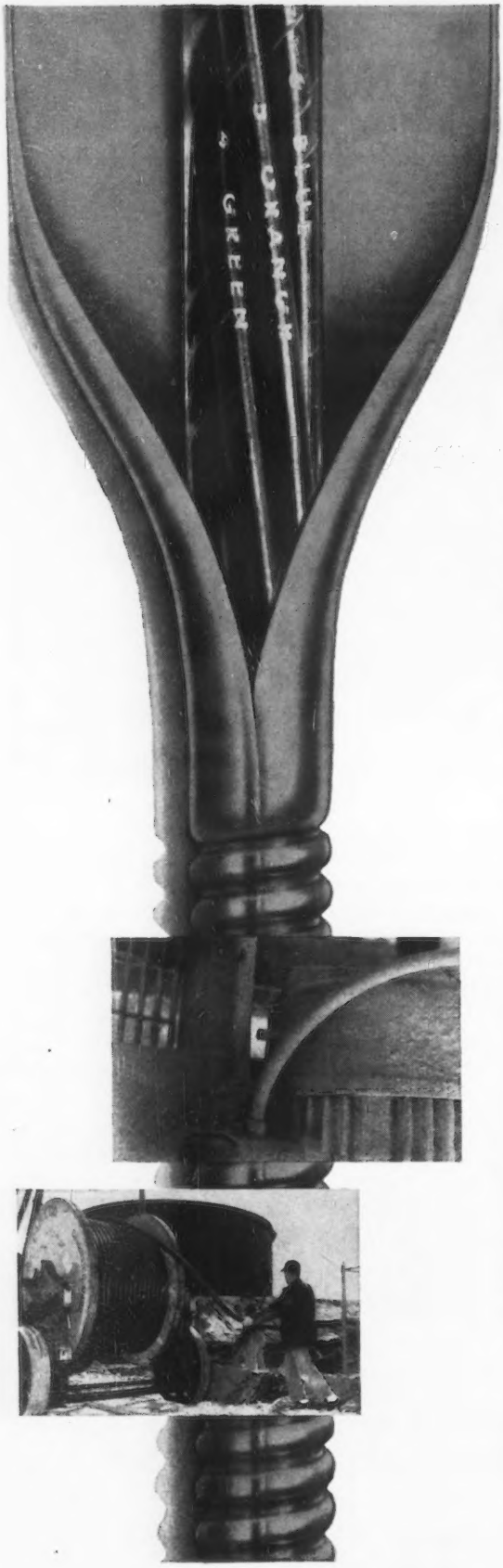


Only C-L-X®
Continuous Lightweight eXterior

Sealed Cable Systems by Simplex Can do so Many Jobs so Well

Simplex C-L-X is a packaged combination of cable and an extremely pliable, corrugated metal sheath. It requires no separate duct or conduit regardless of environment. It is available with steel sheath and plastic jacketing; and with copper or aluminum sheaths, with or without plastic jacketing.

C-L-X Cuts Installation Costs

By using a single length of 3-conductor 15KV C-L-X for both underground and aerial use, a Southeastern utility company saved more than 20,000 dollars from what it would have cost for a complete underground duct system.

Resists Chemical Attack

Conduit life in this company's calcium chloride reclamation building was only 6 to 9 months. The conduit was replaced with a C-L-X cable system which — after two years of operation, shows no signs of deterioration.

Protects Against Liquids and Gases

An East Coast petroleum tank farm used a C-L-X 8-conductor cable protected with PVC for direct burial in ground that was saturated with oil, gas and water. Result: Perfect performance at a sizeable savings over conduit systems.

Only Simplex C-L-X offers you: Exceptional Strength . . . Unequalled Pliability . . . Protection from Liquids and Gases . . . Faster Installation and Lower Costs. Send for Illustrated Brochure containing Application and Engineering Data.

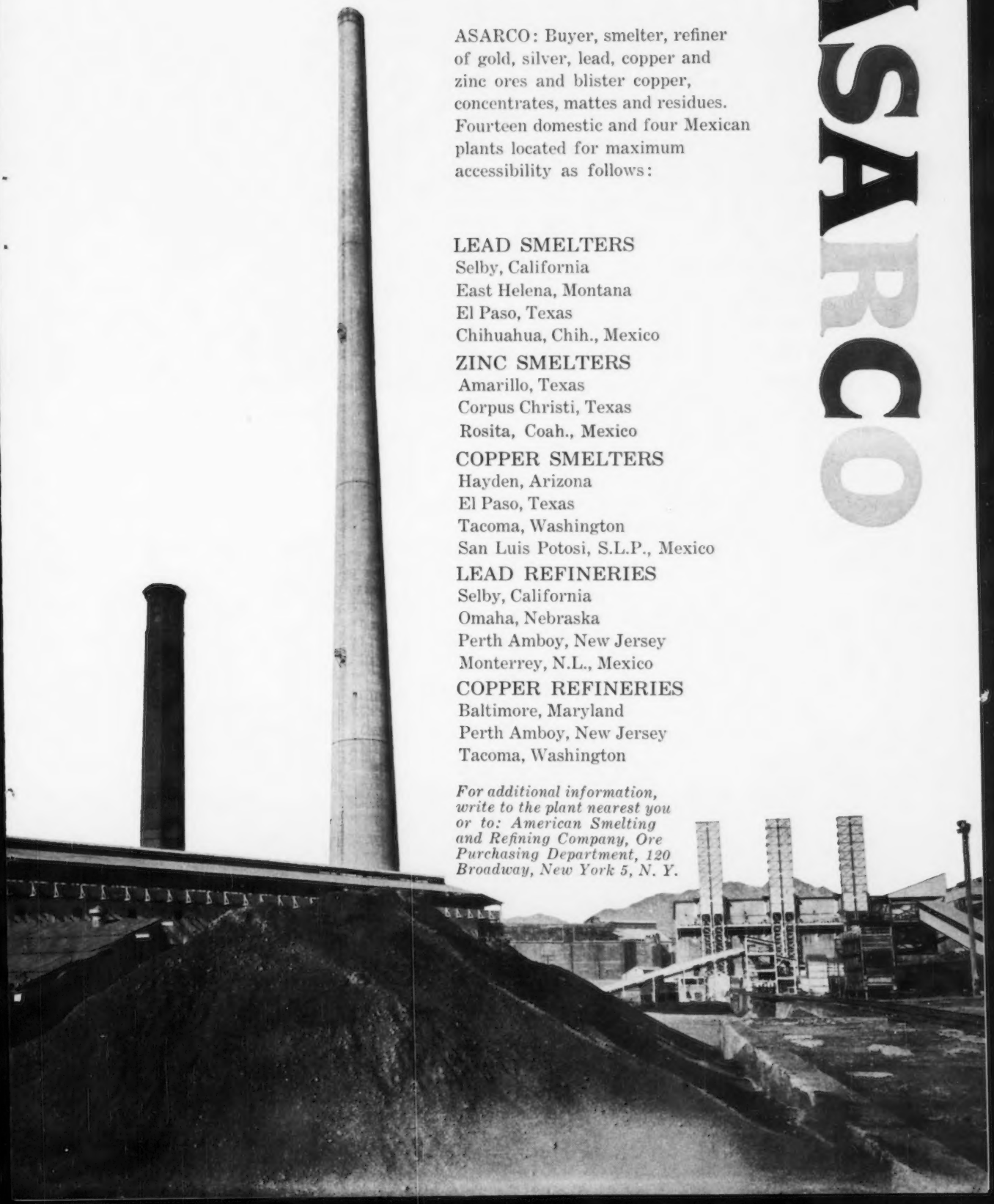
SIMPLEX WIRE & CABLE Co

CAMBRIDGE, MASSACHUSETTS

For carloads or small lots

Eighteen convenient smelters and refineries

ASARCO



ASARCO: Buyer, smelter, refiner of gold, silver, lead, copper and zinc ores and blister copper, concentrates, mattes and residues. Fourteen domestic and four Mexican plants located for maximum accessibility as follows:

LEAD SMELTERS
Selby, California
East Helena, Montana
El Paso, Texas
Chihuahua, Chih., Mexico

ZINC SMELTERS
Amarillo, Texas
Corpus Christi, Texas
Rosita, Coah., Mexico

COPPER SMELTERS
Hayden, Arizona
El Paso, Texas
Tacoma, Washington
San Luis Potosi, S.L.P., Mexico

LEAD REFINERIES
Selby, California
Omaha, Nebraska
Perth Amboy, New Jersey
Monterrey, N.L., Mexico

COPPER REFINERIES
Baltimore, Maryland
Perth Amboy, New Jersey
Tacoma, Washington

For additional information, write to the plant nearest you or to: American Smelting and Refining Company, Ore Purchasing Department, 120 Broadway, New York 5, N. Y.

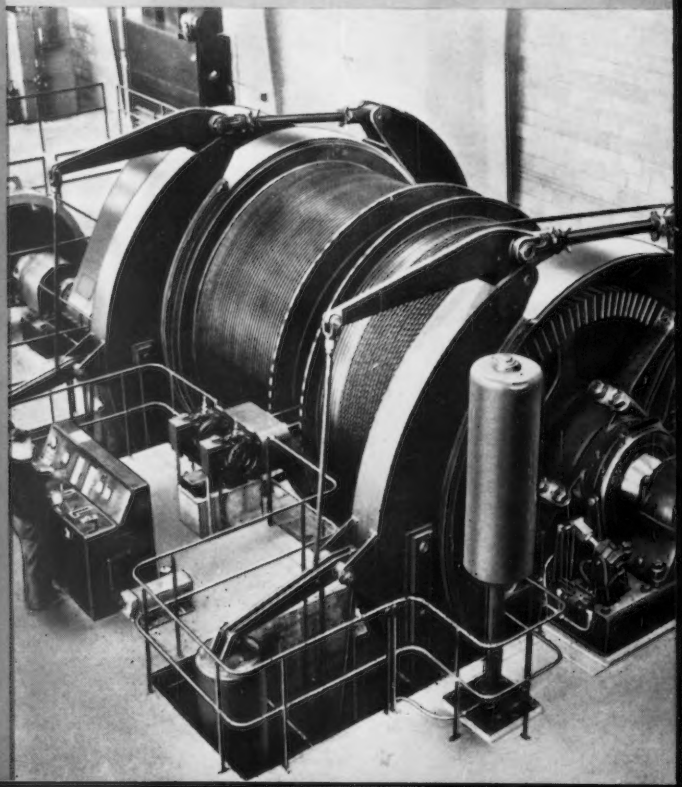
HOW NORDBERG MACHINERY SERVES THE MINING INDUSTRY

IN POWER GENERATION

Nordberg engines are built in sizes ranging from small power units to over 12,000 horsepower in a single engine . . . and are available for Diesel, Duafuel® and Spark-Ignition Gas operation.

IN HOISTING

Nordberg has an established reputation second to none, and can furnish both conventional and friction type mine hoists for men and material, to meet specific requirements.



NORDBERG MFG. CO.
Milwaukee 1, Wisconsin

SYMONS
SCREENS
NORDBERG

SYMONS . . . A Registered Nordberg Trademark Known Throughout the World.

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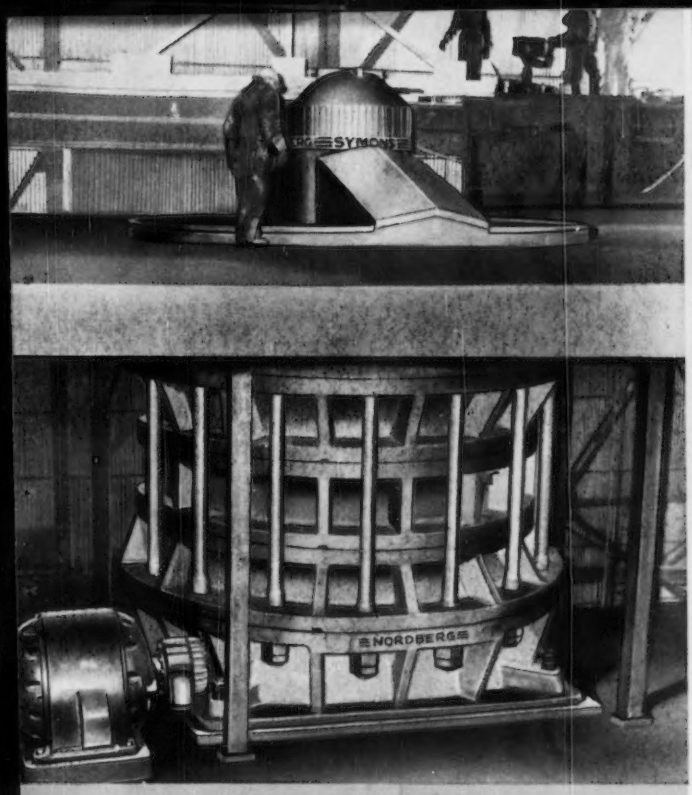
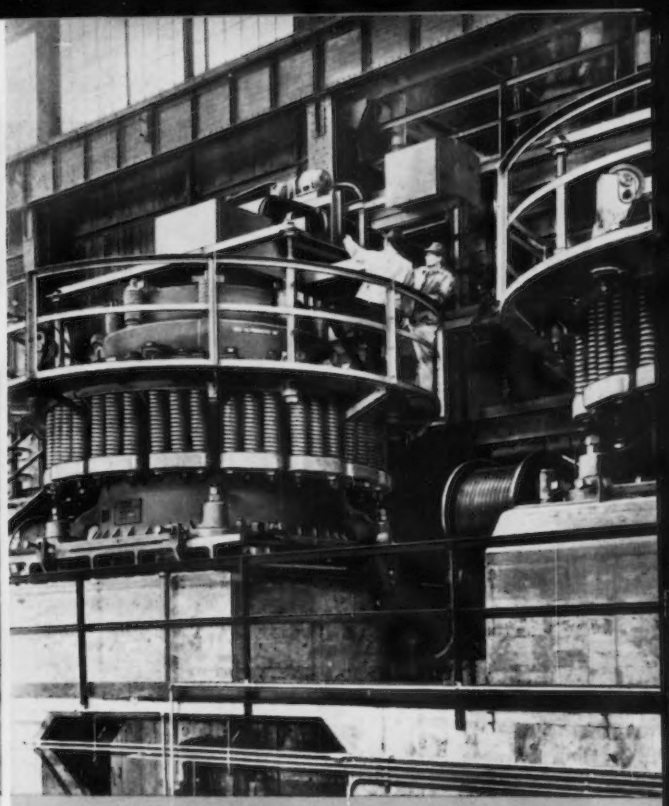
M160-R-2



IN PRIMARY CRUSHING

Symons® Primary Gyratory Crushers are built for big tonnage, heavy duty primary breaking in 30", 42", 48", 54", 60" and 72" feed opening sizes. Capacities to 3500 or more tons per hour.



IN FINE REDUCTION CRUSHING

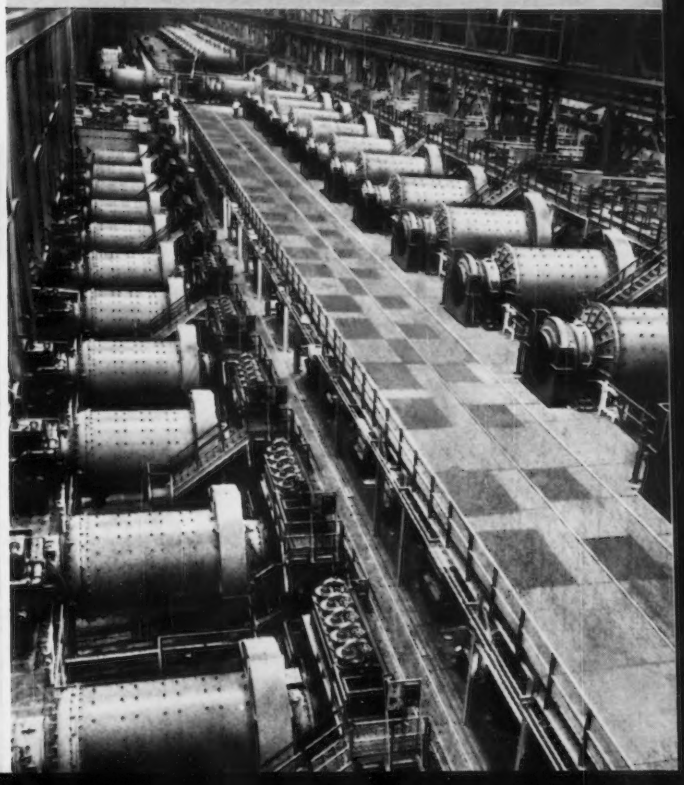
Symons Cone Crushers, the machines that revolutionized crushing practice, are built in both Standard and Short Head types, in sizes from 22" to 7' in diameter. Capacities from 6 to 900 or more tons per hour.

IN SCREENING

From scalping to fine screening, there is a Symons Screen built to do a better job at low cost. Let Nordberg experience help you select the screen best suited to your needs.

IN WET AND DRY GRINDING

Nordberg Grinding Mills include Rod, Ball, Pebble, Tube and Compartment types, in sizes from 6' to 13' in diameter and up to 50' in length.



MANITOWOC 4500 VICON*

the only *really new* excavator design since steam!

This big 7-yd. VICON dragline removes 5,500 yards of shale and sandrock overburden every 10-hr. shift. Making 40-ft. deep cuts, the 4500 VICON is equipped with a 100-ft. boom.

The Manitowoc Model 4500 VICON represents the most outstanding advancement of excavator design in decades. Here is a 6 yard shovel or 7 yard dragline incorporating new, tested design principles to give you more yardage in less time than any other mechanical or electrically driven shovel-drag in this size range. Thoroughly proved on the job for over three years, VICON design has increased yardage 25% or better, substantially reduced maintenance costs, and piled up more profits for owners. Some exclusive VICON features are:

INTEGRATED CONTROLS that serve both as clutch operating levers and as engine throttles, providing variable speed control over each function. Clutches, being responsive to lower range of control pressures, are engaged before engines are accelerated. Slippage and overheated friction surfaces are eliminated, lengthening clutch life appreciably.

HOIST AND DRAG DRUMS ARE INTERLOCKED to automatically synchronize their operation. Cycle time is faster and output is greater because full horsepower is always available for hoist—the operator doesn't "soak" it up with the drag brakes. Operating costs are noticeably less because brake use is cut by 50% and lining wear is drastically reduced. Another advantage of the VICON interlocked drum arrangement is that the operator can "power lower" or free-cast the bucket.

DUAL INDEPENDENT ENGINE POWER with one engine powering the main drums, and the second all other functions. Here are all the advantages of electric or conventional diesel engine mechanical drive without the disadvantages of each. You get the performance characteristics of electric drive — smoother power flow, variable independent speed control, simultaneous operation of dig, hoist, swing, and propel functions—without sacrificing mobility, without incurring the headaches and special maintenance problems of electric drive, without needing a separate power source at every job site. You get the simplicity of mechanical drive without losing valuable production time because of engine "lug down", without needing to jam clutches into engagement at high and harmful engine speeds, without the limitations of operating speeds that are inherent in conventional diesel engine drive.

Why not get the complete story on the *sensational* Model 4500 VICON today? Your nearby Manitowoc distributor has all the facts.

MANIT

8-A1 * Variable Independent Control

Manitowoc

MANITOWOC ENGINEERING CORP.

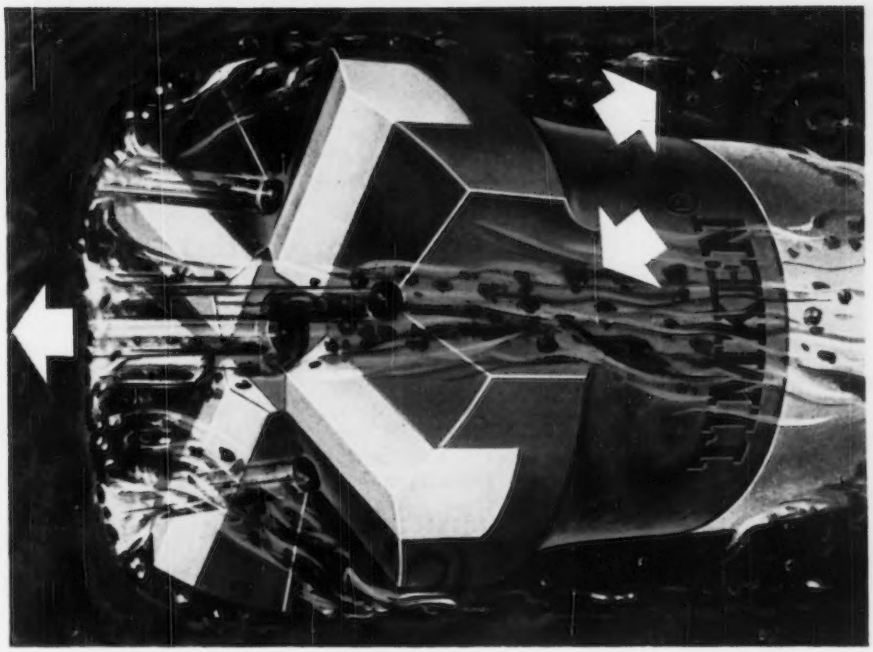
(A subsidiary of The Manitowoc Company, Inc.)

Manitowoc, Wisconsin

SHOVELS	CRANES	DRAGLINES	TRENCH HOES
1¼ — 6 YDS.	25 — 125 TONS	1¼ — 7 YDS.	1¼ — 3 YDS.

WIDER WING CLEARANCE

ALL AIR OR WATER SHOOTS FORWARD



Timken® threaded bits

CLEAR CHIPS FASTER

When you drill, you want to drill rock—not loose chips. You want to prevent wasteful chip-clogging. And you *can,* by using Timken® threaded carbide insert bits. The five front hole design, pioneered by the Timken Company, shoots air or water directly against the rock face to speed chip removal. And with the deeper, wider wing clearance chips clear faster. You save time, speed drilling.

You save in other ways too. The tough, special analysis carbide inserts have better wear resistance. They're deep—can be re-conditioned many times. And bit bodies are made of Timken fine alloy steel for added strength. Result is you get more hole per bit with your drifters, sinkers and stopers.

Timken bits are used by more miners and contractors than any other removable bit. One reason is that with Timken bits you get the kind of "on the job service" from Timken field engineers you can't get anywhere else. Timken threaded bits are available in a complete range of sizes and types. For full details send for free brochure,"Timken Removable Rock Bits". The Timken Roller Bearing Company, Rock Bit Division, Canton 6, Ohio. Cable: "TIMROSCO". Makers of Tapered Roller Bearings, Fine Alloy Steel and Removable Rock Bits.

FOR OTHER TOUGH DRILLING JOBS

ALL-STEEL MULTI-USE

This Timken bit gives lowest cost per foot of hole when you can drill out full increments of steel.

TAPERED SOCKET BIT

Tapered to give strength of one-piece steels. Has the same speedy chip-removal features as the threaded bit shown above.

TIMKEN®

removable rock bits

You can reduce your equipment investment because this D-120

pusher-dozer

can be converted into a tractor-shovel

Now you can buy a big, powerful rubber-tired tractor for bulldozing, push-loading or towing, with or without an optional package for converting the unit into a tractor-shovel.

This new D-120 PAYDOZER, in addition to its convertibility, has numerous engineering and design features which result in outstanding performance and ease of operation.

More power: Weighing 55,000 lbs., the D-120 is powered by a 300 hp. turbo-charged diesel which gives it a higher horsepower-to-weight ratio than other machines of similar size.

Better balance and stability: Approved and exclusive use of dry ballast in all four tires gives better weight distribution and lower center of gravity – dampens tire bounce and permits better blade control.

Inside push arms: Unlike crawler-mounted dozers, all rubber-tired units have push-arm brackets mounted on the main frame. The D-120 push-arms, however, are located inside front wheels, close to main frame for the most direct transfer of forces and the least strain. This also gives greater accessibility to the front wheels for hub and tire servicing.

"Full" power-shift transmission: Hough-built, this unit does not require stopping for range shifts. It is a full-reversing, constant-mesh type with four speed ranges, up to 26 mph., in both forward and reverse.

Matched torque converter: This is *not* a compromise converter for both dozer and shovel application. Instead it is designed specifically for bulldozing and makes fullest use of the tremendous engine power to develop maximum tractive effort. A torque-converter change is part of the bulldozer-to-shovel conversion package.

"Power-transfer" differentials: Provided on both axles for the best possible traction. When one wheel is capable of more tractive effort than the other on the same axle, it can automatically receive 38% more torque.

PAYDOZER is convertible to this H-120 PAYLOADER

"Three-way" power blade control: The D-120 blade is 12′-4″ wide at the cutting edge and 4′-8″ high. Adjustable from 1′-6″ below grade to 3′-2″ above; pitch adjustment of 35 degrees and blade tilt of 10 degrees on either side.

Hydraulic features: The system is closed and pressure-controlled to exclude air-borne dirt and foreign matter. Transmission and torque-converter oil is kept cool by a separate fan-cooled radiator.

Ease of operation: In addition to power-shift transmission there are twin hydraulic steering booster rams, and 4-wheel power air brakes with "Operator's-choice" brake controls – exclusive in its class. These dual foot pedals permit choice of braking with or without transmission engaged for any operating situation.

Standard equipment: Included are open-type cab, front and rear windshields and wipers, special lights and swinging draw-bar. Standard tires are 26.5 x 25 with 29.5 x 25 tires optional.

THE FRANK G. HOUGH CO.
726 Sunnyside Ave., Libertyville, Ill.

Send full data on the Model D-120 PAYDOZER

Name_____

Title_____

Company_____

Street_____

City_____ State_____

2-B-1-M

THE FRANK G. HOUGH CO.
LIBERTYVILLE, ILLINOIS
SUBSIDIARY – INTERNATIONAL HARVESTER COMPANY

HOUGH, PAYLOADER, PAYMOVER, PAYLOGGER, PAYLOMATIC and PAY are registered trademark names of The Frank G. Hough Co.

HOUGH®

HOUGH
PAYDOZER®

MOST VERSATILE AND EFFECTIVE

FOR

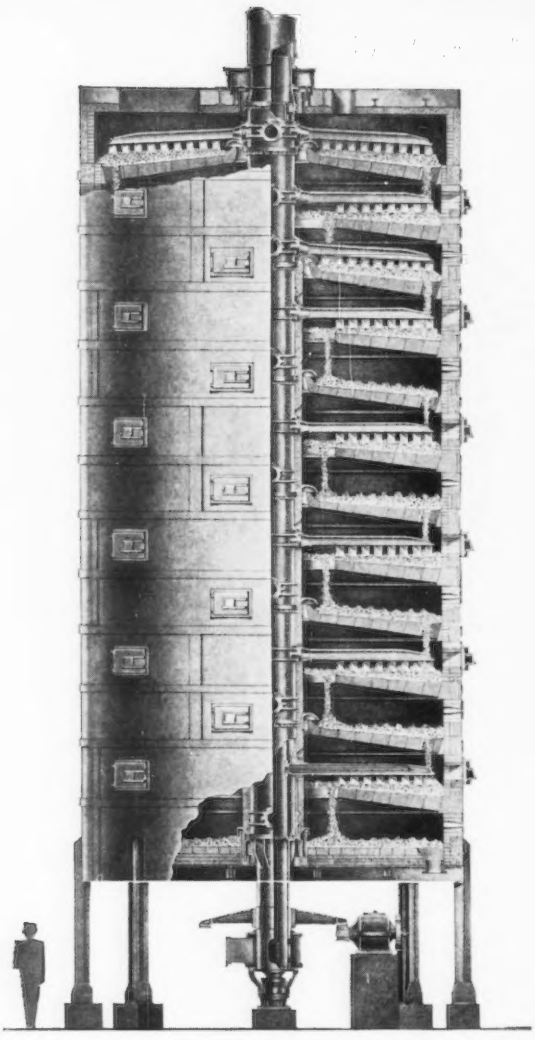
CONTINUOUS PROCESSING

THROUGH

SUCCESSIVE STAGES

OF

CONTROLLED HEAT



Multiple Hearth Furnaces

for ROASTING • CALCINING • DRYING of ORES • CONCENTRATES • CHEMICALS • SLUDGES • WASTES

In PFM Multiple Hearth Furnaces, materials are mixed more effectively and given a more complete, more uniform exposure to heat than is possible in other types of roasters or calciners.

PFM Multiple Hearth Furnaces range in size from small laboratory installations to 16-hearth giants. Complete facilities are maintained for analysis, tests, and pilot runs. You are thus assured of a furnace design, based on actual test operation, that will most efficiently meet your exact requirements.

You are invited to avail yourself of PFM's consultation services, without obligation. For an immediate reply, write to:

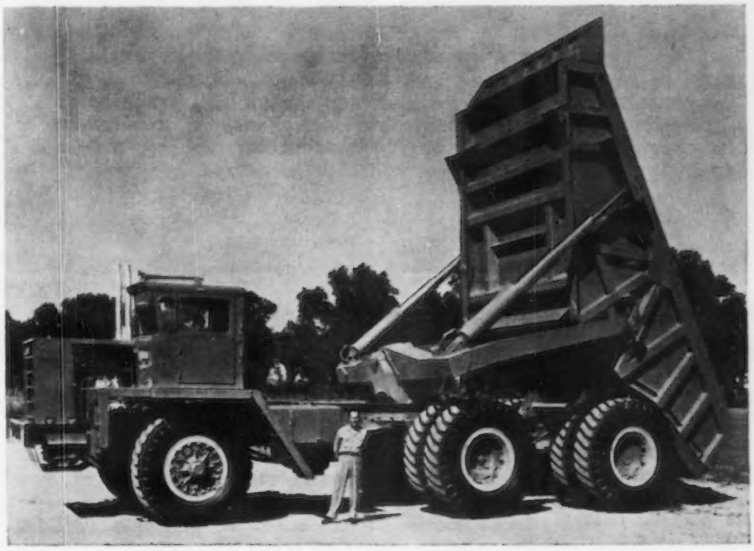
PFM
PACIFIC FURNACE
DIVISION

PACIFIC FOUNDRY AND METALLURGY CO.

NEW YORK • SAN FRANCISCO

3100 Nineteenth Street, San Francisco, California • 551 Fifth Avenue, New York City

World's Largest Production Truck 95-Ton Payload (1)



KW-DART TRUCK CO. is joining the campaign for larger and larger mine haulage equipment, and, after what they term a "year of intensive engineering, construction and testing", now present their 95-ton payload dump truck.

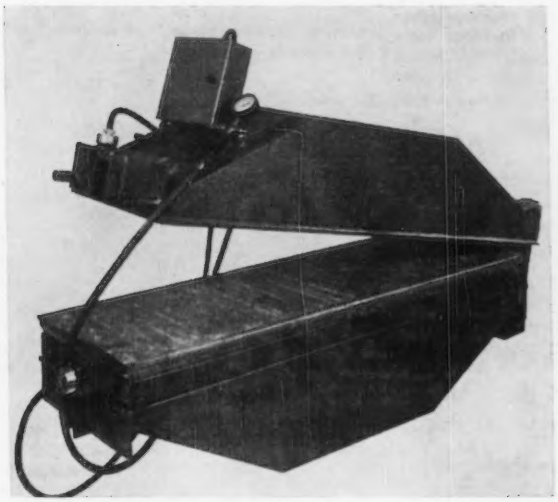
The new hauler, the largest commercial truck in the world, is a tractor-trailer combination. The frame is made of four heat-treated, pressed steel channels which are bolted together back to back, forming an I beam. Rails vary in depth and are deepest at the point of greatest stress, cutting down, the company says, on the vehicle's total weight.

Until recently, the limiting factors in increasing truck tonnage have been the horsepower and tire requirements. As a result, KW-Dart designed the most powerful combustion diesel ever developed for wheeled construction and mining equipment—four cycle V-12 rated at 700 hp. The engine weighs 5700 lb, giving a horsepower to weight ratio of 8.1 lb per hp.

The tires are also able to stand up under the load. Ten of them have a total capacity of 300,500 lb. Vehicle tractor-trailer and body has a combined unladen weight of 120,000 lb, permitting a payload of 190,000 lb. Rear dual wheel tires of the tractor and trailer are 21:00x35 tubless, 36-ply nylon cord. The front tires are 18:00x33, 32-ply tubeless nylon. According to the tire manufacturer, the rims are the largest demountable rims ever used.

Because of the 700 hp available in the V-12 engine, each unit in the power train had to be developed for the 95-EDT. A 19-in. single-stage converter mounted on the engine delivers power to a four-speed power shift transmission equipped with an oil brake.

Truck's radiator is over six ft high and has 3100 sq in. frontal area.



Air Bag Vulcanizer (15)

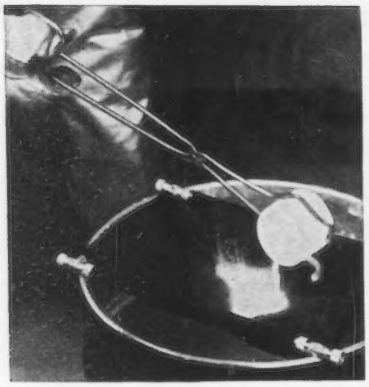
FOR THE FIRST TIME, a portable belt vulcanizer has been developed which gives perfectly even and accurately controlled platen pressure, according to Vulcan Equipment Co. Ltd. Vulcapress, the company says, simplifies belt splicing and reduces failure at lower than unit cost. It can be handled by one man and is easily dismantled for on-the-site repairs.

The vulcanizer's even pressure is obtained by using the pneumatic pressure air bag principle, and, for accurate control, the pressure is indicated on an easily read gage. The lower platen is flexible—assumes the contours of worn belting and compensates for slight irregularities on the belt surface.

High Frequency Screener (16)

DERRICK MFG. Co's new Model "J" high frequency screening unit is completely self-contained and is readily adaptable to many varied uses. It has all-welded frame construction, high frequency vibrating motor, and, Derrick said, the stainless steel or aluminum screens insure accuracy to the most exacting specifications without any external vibrations.

Some of the accessory equipment available with the Model "J" are: dust closures; portable hoppers; wash boxes; feeders and screen heaters. Derrick also notes that specific designs including multiple separations and wet, dry or air screening are available upon request.



Molten Metal Cools on Cloth—No Burn or Residue (3)

ALL-ORGANIC, heat-resistant fiber, which retains its flexibility and part of its strength after exposure to intense heat, is being introduced by Minnesota Mining & Mfg. Co.

The fiber, called "Pluton", is available as a fabric. It also can be worked into laminates reinforced with high-temperature phenolic resin to form structural parts or molding compounds.

Minnesota reports that the fiber has been exposed in a plasma jet to temperatures up to 18,000° F without melting. At one demonstration, a 1-lb slug of molten steel, heated to 3,000° F, was poured onto an unsupported 1-lb-per-sq-yd fabric sample which was stretched across a frame. The molten steel solidified on the fabric without burning through it.

Protective Suit (33)

LIFE-SUPPORT suit with a self-contained "environmental control system" has been designed by Garrett Corp's AiResearch Div. Originally conceived for use in handling toxic missile fuels, the suit is adaptable for use in any area where protection from surrounding atmosphere is needed, such as in fire fighting and rescue work, chemical processing plants, or mines.

The suit's control system consists of a cryogenic air storage cylinder which supplies breathing air, a quantity gauge, an ejector for circulating the air, a heat-exchanger for cooling the re-circulated air and a trap for collecting solids and entrained water.

With its ventilation, cooling, and humidity control, the unit provides a completely self-sustained, habitable atmosphere for the wearer.

Nylon-Cored Belt (14)

CONVEYOR BELTING with core layer of nylon strip oriented to give it exceptional tensile strength and greatly extended service life was recently introduced by Goodall Rubber Co. According to the company, extensive testing has shown that in extremely rugged applications, the new belt can outwear previously accepted belts by from 50 to more than 100% and it requires much less maintenance. The belt was developed in conjunction with Spencer Chemical Co. and Moldings & Extrusions, Inc.

Goodall said that while the orientation process gives the nylon high impact resistance, it also reduces elongation. During tests, not one of the Goodall belts had to be removed for shortening. Impact widening was also practically eliminated.

Flex strength which the nylon strip gives the belt is said to enable it to hug pulleys with minimum slippage. Officials of the firm expect the belt to find greatest use where extremely severe service and comparatively short belt life prevail.

Improved Oil Filter Paper (8)

CONSIDERABLE INCREASE in filtration efficiency without a loss in service life is the main feature of a new lubrication oil filter developed by Caterpillar Tractor Co.

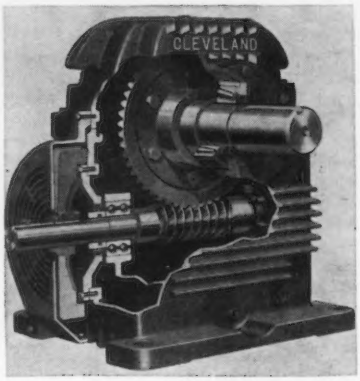
The new element, 7M 3800, replaces the company's 9F 6700 but, aside from the already-mentioned improvement, it has the same outward appearance, dimensions, and cost as the former model.

The increased service life is possible because the new paper is stronger, thicker, and has "deep grooving" to maintain proper fold separation.

Higher Capacity Reducers (13)

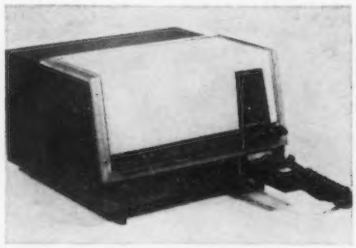
NEW LINE of worm gear speed reducers, made by Cleveland Worm & Gear Div., Eaton Mfg. Co., offers horsepower capacities up to 80% higher than those of conventional reducers of the same type, according to a recent company announcement.

The reducers come in nine sizes ranging between 3-in. and 12-in. center distances. Ratios extend from 4½:1 to



95:1, ratings from fractional to 175 hp.

Cleveland said that the fan cooling system is one of the main features of the new reducers—with a specially constructed radial fan, which is equally effective in either direction, made of plastic or aluminum to make it extremely light. The fan is mounted on the worm shaft's input side to efficiently scout the finned outer wall of the reducer. Mounting in this position eliminates the extra expense and friction loss involved in the additon of another oil seal.



Small Lab Oven (5)

COMPACT LABORATORY OVEN, ideal for drying precipitates and doing other heating jobs to 500° F, has been developed by Planchets, Chelsea, Mich. With the new oven, the company feels, there's no longer any need to tie up large units for small drying jobs, and, as an added advantage, the smaller oven can be brought to operating temperature in minutes.

Some of the other advantages of the Planchet oven are: low cost; combination pilot-light thermostat for dialing any temperature; 1 cu ft of drying space; the top and front lift off in one hinged unit; and protective lips on each of the two shelves keep apparatus from sliding off.

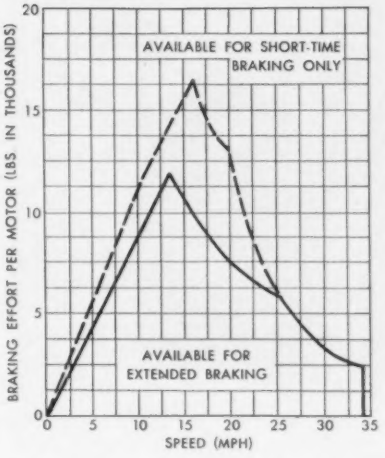
GE Releases Motorized Wheel Braking and Traction Data (30)

General Electric's motorized wheel is no longer something brand new—much has already been said about it and it's off the drawing board and onto actual hauling equipment. Now, however, after having seen just what the wheel can do by comparing the results of varied applications, the company is able to be specific about two of the unit's major advantages: high braking capacity and increased traction.

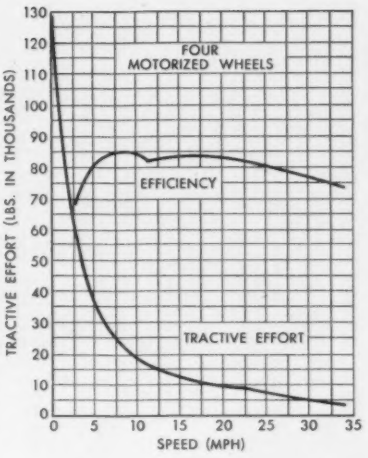
Motorized wheel's high braking capacity without fading or mechanical wear results, GE says, from dynamic braking, allowing safe, economical, high-speed operation.

In descending grades, braking is done electrically by dissipating the vehicle's kinetic energy as heat in the resistors—connecting the traction motors as generators and loading them on braking resistors. According to GE, in addition to dynamic braking, the hydraulically operated disc brake may simultaneously be used.

Additional forces that are not shown on the braking curve include: tire losses, rolling resistance and grade effects.


BRAKING EFFORT PER MOTOR (LBS IN THOUSANDS)
AVAILABLE FOR SHORT-TIME BRAKING ONLY
AVAILABLE FOR EXTENDED BRAKING
SPEED (MPH)

The company's other graph outlines increased traction for two- or four-wheel vehicles, and shows the effort available at the rim for a system available at the flywheel for traction power.



Trouble-Free Pump (11)

LIGHTWEIGHT SLUDGE PUMP, the CP-71, designed to handle liquid containing up to 15% solids and which can eject 40 gpm at 200-ft head, has been developed by the Chicago Pneumatic Tool Co. The pumps is 17 lb lighter than its predecessor, yet is capable of twice as much lift.

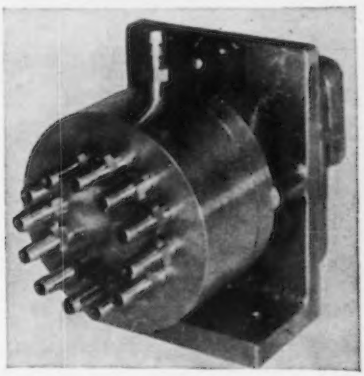
Operating on the ejector principle, the CP-71 handles rock drill cuttings, sand or other solids without causing rapid wear of expensive internal parts. Chicago also says the new pump is practically trouble-free—no diaphragms, stuffing boxes, rotors, impellers and pistons to maintain.

Lake Shore, Inc., (Minnesota Div.) has been appointed distributor for the Bucyrus-Erie line of shovels, cranes, and related equipment in northeastern Minnesota. Lake Shore, already distributor for the same equipment in Michigan's Upper Peninsula, now will oyperate throughout the Lake Superior district.

12-Position Valve (6)

NEW 12-POSITION automatic valve for gas sampling and for feeding gas to chromatographs or mass spectrographs, is being introduced by Gelman Instrument Co.

Twelve separate intake ports are connected to a common vacuum chamber. Each valve is sealed by a spring loaded ball valve except at the time the port



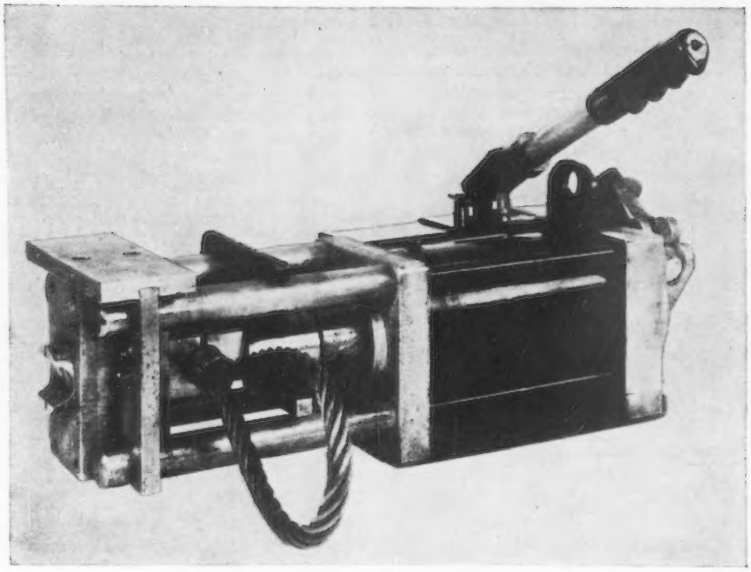
is open for sampling. A cam controls the opening and closing of each port by moving a rod which unseats the ball.

The valve has 12 intake ports and one vacuum port, each tapped for ⅛-in. standard pipe and supplied with hose fittings installed.

Hopper Car Vibrators (10)

HEAVY-DUTY VIBRATORS which cut unloading time on covered hopper cars, eliminate "clean out" of cars after emptying, and free unloading personnel for other work has been developed by National Air Vibrator Co.

The Navco HCP line is designed with an exceptionally long piston stroke for maximum amplitude and thrust, and the piston is the only moving part. Units have stainless steel mounting head for long life—use no body assembly bolts to wear out or fatigue. National claims that the vibrator's exclusive "free ride" design gives continual effective action in contrast to conventional models that tend to jam in the mounting bracket, cutting vibrator action.

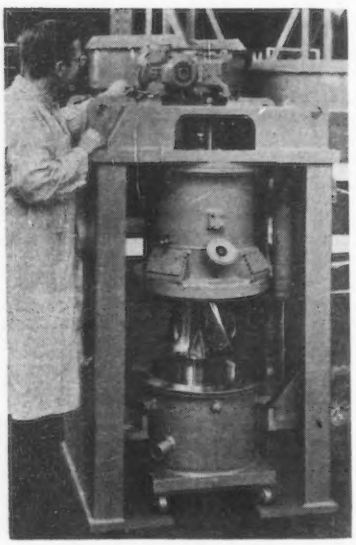


Bench Unit for All Types of Cable Processing (2)

SMALL, EASY TO USE cable processing unit that cuts and repairs cable, makes slings, eyes, chokers and splices right on the job is being manufactured by Mark Naught, Inc.

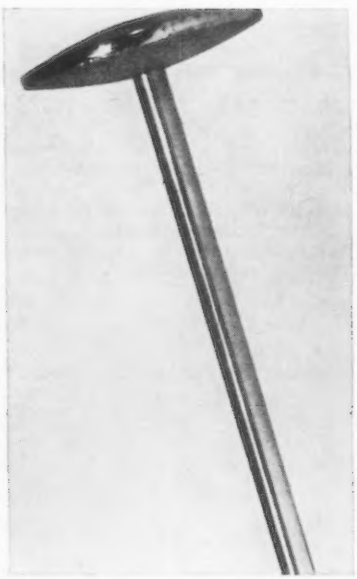
The new machine, called the Mighty Mark, weighs less than 70 lb but can exert pressures up to 15 tons and handles cable up to ½ in. under all types of conditions. Mark says their larger machines can handle the thicker cable.

Some of the advantages of the new device, according to the manufacturer, are: ability to work almost anywhere (even under water); an operator can learn to use the Mighty Mark in a few minutes; no outside power is required; cable can be processed in amazingly short time; can be moved about with ease; and cutting without fraying or leaving jagged edges.



Abrasive Materials Mixer (4)

A VERTICAL PLANETARY MIXER of five-gallon capacity, made by Baker Perkins Inc.'s Chemical Machinery Div., is suitable for use where contamination between batches of materials must be avoided. The mixer will process between 50 and 70 lb of abrasive materials, such as reagents, in a single batch. The compounding is done in a stationary, jacketed container, which can be removed for discharging and cleaning while another is put in its place. The mixer's two stainless steel agitator blades operate at a differential speed of 2:1, and provide double planetary motion to ensure proper mixing. The mixing containers are of stainless steel, and are designed to circulate either water or steam at 80 psig. Casters on the bottom of the containers facilitate removal and replacement. A three horsepower motor drives the mixer.



Stainless Steel Lab Filters (7)

MICRO METALLIC DIV., Pall Corp. is introducing a redesigned line of porous stainless immersion tubes, beaker filters, and gas dispersion tubes. All of the new units feature type 304 stainless steel tubes heliarc welded to the center of type 316 porous stainless steel filter elements.

Micro announced that the filters are available in five porosity grades, with average pore openings of 65, 35, 20, 10 and five microns. They can be heated to 400°C without having oxidation change their weight. According to the company, the filters, by combining light weight and high flow rates with resistance to thermal or mechanical breakage, are suitable for a variety of laboratory uses.

Linear Position Detector (37)

CONTINUOUS METER MEASUREMENT of fluid levels or of the linear position of any mechanical device, within 10 ft travel-limits, is possible with the Position Indicator made by Gems Co. Inc. The indicator consists of a simple probe-and-float arrangement. The float, which rides freely the length of the probe, may be attached to any device which moves linearly, or may be used as a liquid level follower when the probe is placed upright in a tank or pool. The probe-riding float is magnetically followed inside the probe by a contact which shunts out an electrical circuit on the Wheatstone Bridge principle.

For Your Files

This selected manufacturer's literature is free unless otherwise specified. If item is for sale, send request and money direct to manufacturer.

LAST YEAR (E&MJ, Sept. 1960, p52) the New Products Digest featured Collectron Industries Ltd.'s electrostatic collector that can handle any type dust problem. Now the company has come out with a bulletin which studies various aspects of electrostatic air filters.

Beginning with a discussion of the theory of electrostatics, Collectron then looks into ionization, dust collection, efficiency (with an efficiency table), and then, in four pages, gives a diagrammed analysis of the components of the Collectron filter. **(81)**

NEW 24-PAGE BOOKLET, "Lubricants for Aluminum Working," has just been published by Reynolds Metal Co., which believes it is the first such guide for the metal working industry.

The booklet lists lubricants for 19 metal working operations and these are keyed to each of the operations, which include: blanking, bending, piercing, cold and hot forging, ironing, necking, roll forming, etc. **(82)**

MODEL C SPEEDPULL, LeTourneau-Westinghouse Co.'s 20 cu yd (heaped) capacity six-wheel tractor-scraper combination, is fully illustrated and described in a 16-page bulletin. **(83)**

COMPLETE LINE of Oxweld flame-cutting machines is described in a 28-page catalog available from Linde Co., Div. of Union Carbide Corp. **(84)**

T. B. WOOD'S SONS CO. has published a four-page bulletin (22103), which covers their complete line of "Sure-Grip" flat-belt pulleys in face widths from 2½ to 12 in. and O.D. from 4 to 26 in. **(85)**

REVISED 12-PAGE specification bulletin covering the Series "350" BANTAM crane-excavators has been prepared by the Schield BANTAM Co.

The bulletin contains complete capacity charts, work ranges, features, and other specifications on the 11-ton carrier-mounted Model T-350, the 11-ton self-propelled Model CR-350, and the 8-ton Model C-350 crawler-mounted BANTAM, as well as the complete line of front end attachments. **(86)**

CLARK C-LINE of packaged air compressors (four models rated at 25, 50, 75, and 100 hp respectively) is introduced in a new bulletin (203) from Clark Bros. Co., Div. of Dresser Industries, Inc. **(87)**

COMPLETE LINE of differential expansion type temperature controls is described by Burling Instrument Co. in its new Catalog G-25. Both electric and pneumatic instruments are covered. Units are available for temperatures up to 2,000°F and in choice of standard, water tight, or explosion-proof enclosures. **(88)**

WET PERMANENT DRUM SEPARATORS, offered by Stearns Magnetic Products, are discussed in the company's new Bulletin 2013. The units, available in both concurrent and counter-rotation styles in a variety of colors are, according to Stearns, in wide use primarily as concentrators of magnetic ores and for the recovery of magnetic media in heavy-density separation systems.

The INDOX V is fully described and complete specifications are given on all sizes offered. **(89)**

REVISED 36-PAGE Bulletin 7100, published by the Falk Corp., presents shaft-mounted drives and a new series of flange-mounted drives covering a torque range up to 44,000 lb-in.

Falk said the new bulletin includes design and construction advantages as well as selection and dimensional data, engineering drawings, accessories, and typical application photos. The new Falk Equi-Poised motor mounts for use with shaft mounted and flange mounted drives are also fully described in the company's literature. **(90)**

"CUSTOM ALLOY STEEL CASTINGS," put out by ESCO Corp. (formerly the Electric Steel Foundry Co., contains technical data on heat, corrosion, and abrasion resistant steels. Charts listing nearly half of the more than 100 available cast alloys are included, as well as descrip-

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1	11	21	31	41	51
2	12	22	32	42	52
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No. 1

tions of ESCO's services and casting methods. **(91)**

ACOUSTICA ASSOCIATES, INC., has prepared a folder describing its unitized liquid-level switch, which combines an ultrasonic probe and a transistorized control into an integral unit.

In addition to specifications, Acoustica said, the folder tells how the liquid-level sensor, either as an integral or separate unit, is capable of monitoring a large variety of liquids. **(92)**

CATERPILLAR TRACTOR CO. has published a new bulletin (form (33879) to describe the engineering and design features, which they say make the Caterpillar 619B-442 Tractor-Scraper team a top producer.

Power, speed, safety and roadability, easy servicing and loading characteristics are discussed. **(80)**

NEW MODEL 305-S single shaft gas turbine for mechanical and generator drive is presented in Bulletin186, just released by Clark Bros. Co., one of the Dresser Industries.

Important advantages, such as the 9,000-hp unit's simplicity, reliability, compactness and low first cost, are fully discussed. All of the turbine's important design features are detailed in photographs and a cutaway cross section. These include: multi-stage axial compressor, air cooling of the turbine discs and blade roots, unitized contra-flow combustion chamber, horizontally split casing, and fabricated steel base plate with integral lube oil reservoir. **(93)**

APPLICATION of packaged hydraulic systems to solve a wide range of process control problems is the subject of a new six-page bulletin (I-5802) from Vickers, Inc. Whether used for valve control or power transmission, Vickers said, the systems set the standard for simplicity of installation and reliability in operation. **(94)**

A HANDSOME 44-page booklet, published by the Gelman Instrument Co., sets forth a comprehensive list of the company's new equipment for dust surveys, air-pollution analysis, radiation protection, and submicron filtration. The booklet, "Dust Topics," gives complete specifications, operating characteristics, and prices on all items.

Some of the units illustrated and explained are: bantam air sampler; miniature vacuum-pressure pumps; thermo-anemometers, and high capacity vacuum pumps. **(95)**

JONES & LAUGHLIN STEEL CORP. recently published two new brochures describing their new alloy steel series, Jalloy-S and Jalloy-AR.

The brochures contain detailed mechanical chemical information about the properties of Jalloy-S, the constructional series, and Jalloy-AR, the abrasion-resistant series. **(96)**

ASEA PRESSDUCTOR is a magneto-elastic load cell for measuring medium and large forces and weights. It comes in a number of standard sizes, the smallest for measuring up to one ton and the largest for several thousand tons. Pressductors are used in an almost endless number of industrial applications and one of them, the type TGPH, weighs the contents of an ore pocket in a mine.

ASEA Electric, Inc., has now put out a series of booklets describing all phases of pressductor installation and application. A few of the presentations give excellent background information about pressductor and list the various jobs that each unit is capable of doing. One booklet, however, describes a certain operation in detail and explains how the pressductor can be used as a crane weighing unit. **(97)**

12-PAGE MINE and quarrying catalog, featuring specifications and engineering data for "Super-Aire" heavy-duty blast hole bits, has been published by Security Engineering, one of the divisions of Dresser Industries.

In addition to outlining the complete line of "Super-Aire" bits, the catalog offers, a three-page air drilling guide. **(98)**

GE HAS PUBLISHED a valuable 12-page contribution to the growing electric wheel library. Ten advantages of the company's Motorized Wheel are both described and illustrated. Two graphs (one for comparing braking capacity and the other for traction) are what really make the new booklet important—it's the first time such specific data have been released. **(99)**

FLEXIBLE HOSE prices and general data listings plus selection and installation information are contained in Flexaust Co.'s new Bulletin 605. **(100)**

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Primacord®

for maximum efficiency and safety when blasting with cap-insensitive explosives

Adequate priming is essential for maximum explosive performance and blast results when using prill-oil mixtures, nitrocarbonitrates or any other type of cartridged or bulk *cap-insensitive* explosives. Accordingly, explosives manufacturers have developed a variety of special, high-strength primers and, in all instances, these special primers are designed so they can be used with, and detonated by, Primacord Detonating Fuse.

This combination of cap insensitive explosives, special primers and Primacord, provides maximum economies, safety, plus other advantages for the majority of open pit, quarry and construction blasting. The use of many millions of feet of Primacord over the years has proved its great number of advantages.

1. Detonates at a speed of almost four miles per second along its entire length.
2. Has a minimum initiating strength of a blasting cap along its entire length.
3. Cannot be set off by sparks or stray electrical currents—or by normal vibration, friction or shock.
4. Is simple, easy, and economical to use.

Used as a downline, Primacord simplifies multiple priming and/or deck loading techniques. Saves time and labor costs when loading. As a trunkline, it connects all holes for instantaneous or surface delay initiation. Available in standard and special types, developed to meet varying needs. For further information, consult your explosives supplier or write

THE ENSIGN-BICKFORD COMPANY
Simsbury, Connecticut • *Since 1836*
THERE IS A TYPE OF PRIMACORD® FOR EVERY TYPE OF BLASTING

Free! For the complete story of Primacord, ask your explosives supplier for your copy of the handy new guide and condensed manual: **"PRIMACORD DETONATING FUSE . . . What it is . . . How to use it."** Or write to us giving your name, title and company address. Your copy will be sent promptly.

TGS....

RAIL AND WATER SHIPMENTS

In order to better serve our far-flung customers in the process industries, we have developed at Beaumont, Texas the most modern Sulphur storage, handling and loading facilities in the world. This terminal and shipping center is now receiving deliveries from all four major TGS properties in Texas: Spindletop, Moss Bluff, Newgulf, and Fannett - the most recent mine to be developed.

. . . . *is now operating at* **Beaumont, Texas**

THE WORLD'S NEWEST SULPHUR TERMINAL

. . . for Solid Sulphur

. . . for Molten Sulphur

A few of the design features of this terminal may be of interest:

- **It receives, stores, and loads both solid and molten sulphur.**
- **It can load simultaneously 1 dry cargo ship of 20,000 tons capacity, 3 molten sulphur barges and 1 molten sulphur tanker. There's a holding dock where a second cargo ship can be tied up. The barge basin will accommodate 12 sulphur barges.**
- **Storage capacity totals 31,000 tons for molten sulphur and 1,000,000 tons for solid sulphur. Loading capacity for molten sulphur ranges up to 3,000 tons/hour, tanker and barge simultaneously; for solid sulphur the loading capacity is 1,200 tons/hour into ship or barge.**

This development at Beaumont is but another step in the broadening delivery service program now being carried out by TGS. Regional distribution centers, handling molten sulphur, are already in operation at Cincinnati, St. Louis and Tampa. Coinciding with the full operation of our main terminal at Beaumont will be the opening early in 1961 of two coastal terminals at Carteret, New Jersey, (26,000 tons molten sulphur storage) and Norfolk, Virginia (20,000 tons). Other terminals are in the planning stage.

TEXAS GULF SULPHUR COMPANY
75 East 45th Street, New York 17, N. Y.
811 Rusk Avenue, Houston 2, Texas
Sulphur Producing Units: **Newgulf, Texas • Spindletop, Texas Moss Bluff, Texas • Fannett, Texas • Worland, Wyoming • Okotoks, Alberta, Canada.**

THIS IS MARION QUALITY.

Strange things can happen to steels in the −50° temperatures encountered on the Iron Range. At such readings, ordinary steels can snap like brittle spaghetti. It's one of the big reasons why Marion uses high strength, high alloy steels at vital points throughout their intermediate size excavators. But, these new steels offer machine owners more than just excellent cold strength characteristics. For one thing, they're more resistant to fatigue and heavy shock loading. More important, their inherent strength permits lighter construction. That means your operator is lifting less dead weight... more payload. The man in the picture? Marion takes nothing for granted. He's performing one of dozens of quality check tests that every piece of steel undergoes, from the Marion laboratory to the final assembly station. The long way around? Perhaps. We're willing to let the profit figures for these Marions settle that one. Marion Power Shovel Company, Marion, Ohio. A Division of Universal Marion Corporation.

MARION

SERIES 5000
For intermittent operation . . .
relatively low capacity.

SERIES 6000
For continuous operation . . .
moderate capacity.

759 ways to solve your idler problems

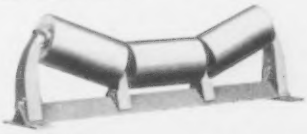
Link-Belt idlers in standard types and sizes to meet every conceivable belt conveyor need

You're sure to find the exact idler to perfectly match your belt conveyor requirements from the complete Link-Belt line of 759 types and sizes.

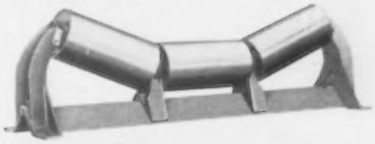
This broad line enables you to select a size idler that exactly matches your needs, no over- or under-engineering. Power requirements are held to a minimum. In addition, anti-friction bearings, accurate roll alignment and rugged construction provide maximum life for idlers and conveyor belt in light- or heavy-duty service.

Link-Belt idlers are available with end rolls inclined at 20°, 35° and 45° for a broad range of belt widths. Matching lines of troughed belt rubber cushion, troughed belt training, return belt and rubber tread return belt idlers are also available. Call your nearest Link-Belt office or authorized stock-carrying distributor for full details. Look for CONVEYORS in the yellow pages of your phone book. Or write for Book 2716.

SERIES 7000
For continuous operation, higher capacities, heavyweight, abrasive materials.



SERIES 8000
For continuous operation, higher capacities, heavier-weight, abrasive materials.

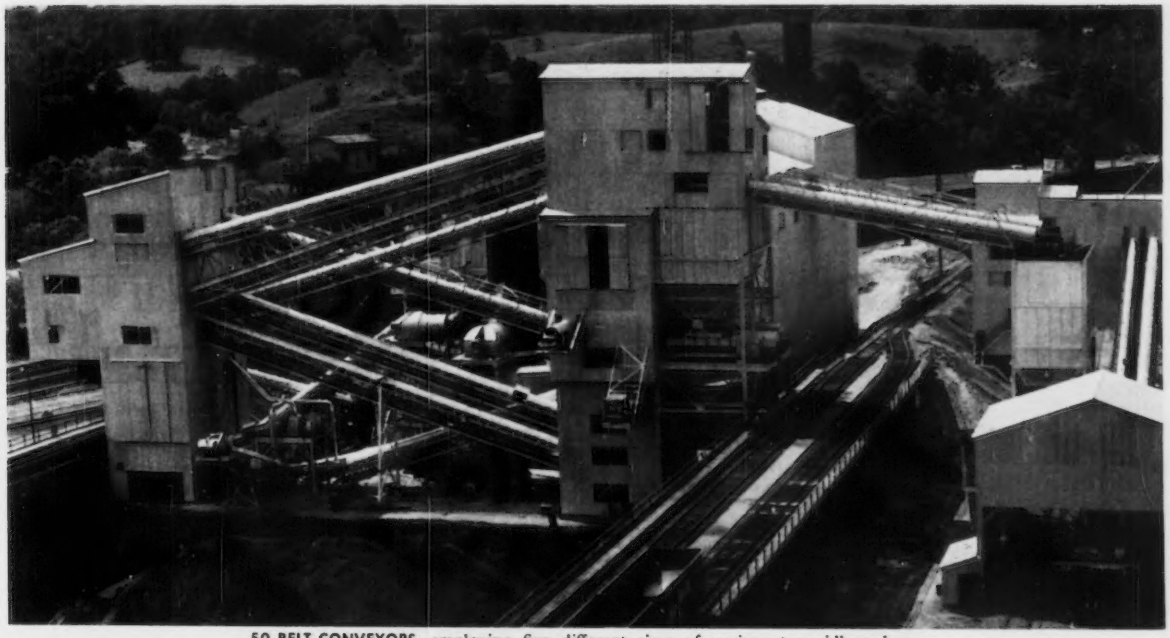


SERIES 9000
For continuous service, highest capacities, heaviest and coarsest materials.

LINK-BELT

BELT CONVEYOR IDLERS

LINK-BELT COMPANY: Executive Offices, Prudential Plaza, Chicago 1. To Serve Industry There Are Link-Belt Plants, Warehouses, District Sales Offices and Stock Carrying Distributors in All Principal Cities. Export Office, New York 7; Australia, Marrickville (Sydney); Brazil, Sao Paulo; Canada, Scarboro (Toronto 13); South Africa, Springs. Representatives Throughout the World. 15,407

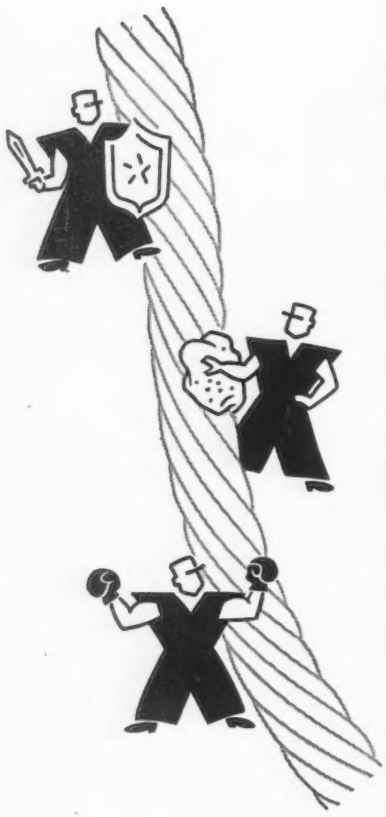


50 BELT CONVEYORS, employing five different sizes of various type idlers, keep raw materials moving steadily through this sintering plant of Armco Steel.

DOUBLE GRAY-X®

...the wire rope with the

EXTRAS



First — because it's made of *extra* improved plow steel — Double Gray-X has *extra* high breaking strength (15% higher than the catalog breaking strength of non-premium ropes of the same construction). Second — due to Wickwire's new wire drawing process — Double Gray-X gives *extra* long service. Double Gray-X has:

MOLECULAR SHIELD

The use of molybdenum disulphide in the wire drawing results in a shield several molecules thick which lubricates the individual wires and prevents them from grinding against each other when the rope operates. Less internal friction means more rope life.

SMOOTHER WIRE SURFACE

Before Double Gray-X, the most carefully drawn rope wire contained minute surface imperfections. Wickwire's new wire drawing technique improves the surface finish. Smooth surfaced wires provide better resistance to fatigue.

EXTRA TOUGHNESS

Molybdenum disulphide lubricates the wires during the drawing process. Less power is required and less heat is generated during this operation. The original inherent toughness of the wires is better preserved.

Double Gray-X is available in many different sizes and constructions. To reduce your operating costs, you should insist on Double Gray-X. For complete information, contact your local Wickwire distributor. We'll be glad to give you his name and address. Write to Wickwire Spencer Steel Division, Wire Rope General Sales Department, P.O. Box 232, Palmer, Mass.

7953

WICKWIRE ROPE
DOUBLE GRAY-X
DOUBLE GRAY-X
CF&I PRODUCT

WICKWIRE ROPE

THE COLORADO FUEL AND IRON CORPORATION

DENVER • OAKLAND • NEW YORK

CF&I STEEL

IN THE COPPER INDUSTRY

the lining is basic . . .

and General Refractories Company is the world's foremost supplier of basic brick

● Grefco RITEX "CB" (Burned Chrome-Magnesite) brick are used to line copper-anode casting furnaces and holding furnaces. Other Grefco basic brick are sometimes used for this service to meet special conditions. Grefco RITEX "CB" will provide long, trouble-free life.

KROMEBOND, Grefco's basic mortar, has been preferred for many years as a superior bonding material for laying basic brick. Grefco KROMSET is suggested where a strong air-set is desired.

Call Grefco's experienced sales and service representatives for any requirements of refractories, or, if you prefer, contact the main office of General Refractories Company, 1520 Locust Street, Philadelphia 2, Pa., Telephone PEnnypacker 5-2000.

Plants manufacturing Grefco basic brick are located at Baltimore, Maryland; Morrisville, Pennsylvania; Gary, Indiana and Lehi, Utah. Grefco's brands of basic brick are available in Canada from General Refractories, Ltd., Smithville, Ontario.

GENERAL REFRACTORIES COMPANY

General Offices: 1520 Locust Street, Philadelphia 2, Pa.

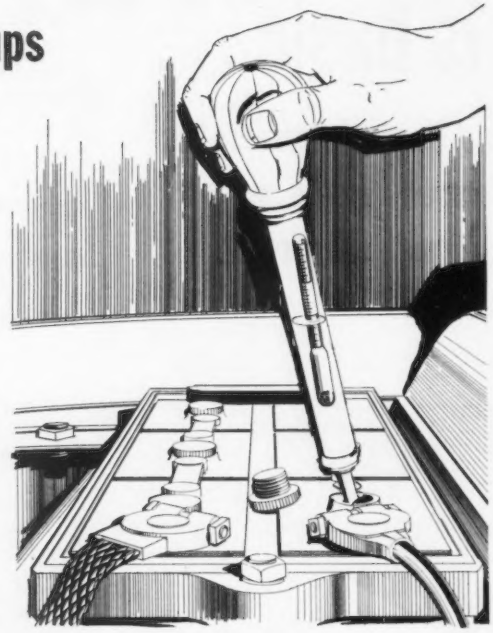
DISTRICT SALES OFFICES IN ALL PRINCIPAL CITIES

GENERAL REFRACTORIES

LUBE LOGIC

Winter maintenance tips

Now's the time for battery check-ups



With cold weather your batteries will be working harder than ever. Here's how you can help make sure they're up to it.

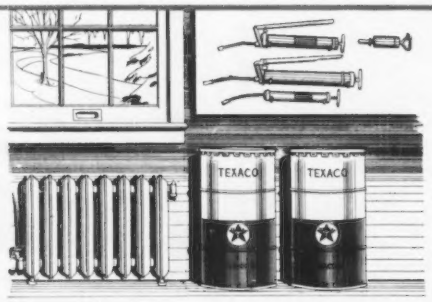
Inspection

- Inspect battery case for cracks and leaks. See that vents in cell caps are open.
- Check battery posts and cable clamps for looseness, breakage or corrosion.
- Using distilled water, bring electrolyte in each cell up to level indicated in cell fill opening.

Hydrometer test for specific gravity

- Use a temperature-corrected hydrometer to test the state of battery charge. Make sure battery has not been recently fast-charged, nor water added.
- Draw enough fluid from each cell to raise float off bottom of hydrometer tube. Holding hydrometer straight up-and-down, take eye-level reading of the neck of the float. Repeat for each cell.
- Note the temperature, and correct hydrometer reading by subtracting 0.004 from the reading for each 10°F below 80°F. (Example: if hydrometer reads 1.280, and temperature is 70°F, correct the reading by subtracting 0.004 from 1.280. The correct reading is 1.276.

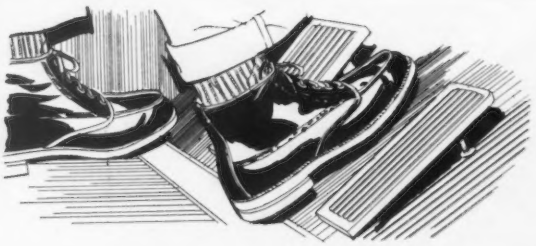
Normal state of charge for 12-volt battery is 1.260 to 1.280 specific gravity. For a 6-volt battery, normal charge is between 1.265 and 1.290 specific gravity.



Grease guns like it warm

Not too hot—just nicely warm. Store grease guns this way, properly racked to avoid damage, and they'll give you much better service. Incidentally, lubricants like to be stored warm, too.

Warm up the guns if they're too cold to pump the lubricant. Best way is to bring them into a warm place far enough in advance of use. Don't ever attempt to warm them up by direct application of heat.



'Easy does it' after an oil change

When an engine's crankcase is drained, so is the oil pump's intake screen and pipe. And when the engine starts up after the change, the oil pump must first suck up a lot of thin, squashy air before it starts chewing oil. To avoid possible damage to the engine, idle it at first at low speed. The oil pressure should begin picking up in a matter of seconds and reach normal reading within several minutes. Wait until it does—before you start working the engine.

TEXACO LUBRICATION ENGINEERS

From time to time we'll bring you "sleepers" like these, little angles that can mean big savings in time and money. But for any specific lubrication problem, call on your local Texaco man. He's your best source of money-saving lubrication ideas. Remember, "lubrication is a major factor in cost control." Texaco Inc., 135 East 42nd Street, New York 17, N.Y.

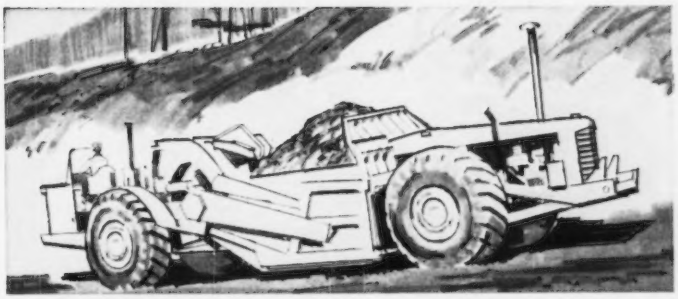
TUNE IN: TEXACO HUNTLEY-BRINKLEY REPORT, MON. THROUGH FRI.—NBC-TV

TEXACO

Throughout the United States

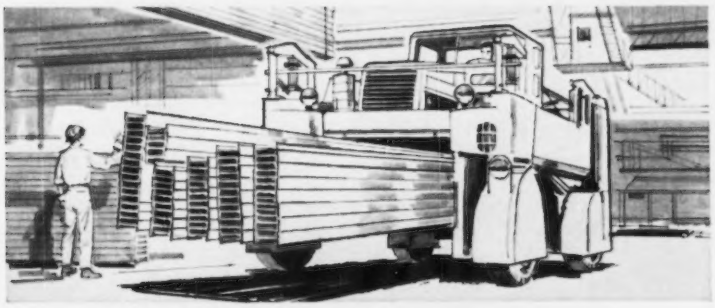
Canada • Latin America • West Africa

ALLISON
smooths out starts
TORQMATICALLY



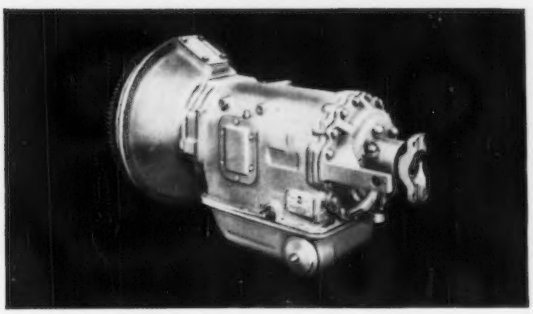
IN 14-YARD SCRAPERS

"Twin Power"—made possible by twin Allison CT-3340 TORQMATIC DRIVES in this Euclid TS-14 scraper—makes every operation smoother. Production is as much as 100% higher, cost per yard 50% less, than for scrapers pulled by tractors.



IN STRADDLE CARRIERS

"Easy Does It" for 30-Ton Loads—Equipped with an Allison CT-3340 TORQMATIC DRIVE, this Gerlinger Material Handler starts 20- and 30-ton loads slick as a whistle for an Eastern steel producer. Unit works 24 hours a day, five days a week, has cut steel handling costs 50%.



IN ANY 125-175 H.P. UNIT

Small off-highway trucks, fire trucks, airport tow tractors, graders—a whole long list of equipment becomes better equipment with an Allison CT-3340 TORQMATIC DRIVE.

This torque converter-hydraulic transmission team has 4 speeds forward, 2 reverse—converter-driven PTO—drive line parking brake—full power shifts at all speeds—optional lockup clutch—can be direct or remote engine mounted.

Want more information? Send for the fact-packed CT-3340 brochure today.

Allison TORQMATIC

TORQMATIC® DRIVES

The world's most complete line of hydraulic drives

Over 980 Models Used by 108 Manufacturers in 100 to 525 H.P. Equipment

Allison Division of General Motors
Dept. MJ-3, Indianapolis, Indiana

Please send me application data on your CT-3340 TORQMATIC DRIVE.

Name_____

Title_____

Company_____

Address_____

City_____ State_____

ONLY LOADER WITH . .

You shift from any one gear to any other—forward or reverse . . . on-the-go. Allis-Chalmers tractor loaders make fast work far easier for any operator.

It's simple for a tractor loader operator to work faster—get more done. It's just as easy for him to go into a high gear as into a low gear—forward or reverse. ONE LEVER controls both speed and direction. No fumbling around with two or more levers or a combination of levers and foot pedals.

Besides operating simplicity, a tractor loader has *firmly connected axles*—attached to frame with 2-inch diameter steel pins . . . no rolling and shifting under load. *Extra stability* lets operators get and deliver

move ahead with

. SINGLE-LEVER SHIFT

bigger loads with greater comfort. Add *extra reach* for fast, even dumping and you can see why production is higher with an Allis-Chalmers tractor loader. Let your dealer show you. Allis-Chalmers, Construction Machinery Division, Milwaukee 1, Wisconsin.

The "Big Three" tractor loaders range in size from the TL-14 with 5,300-lb carry capacity to the TL-20 (shown) with 9,000-lb carry. Each has a family of buckets—18 bucket loader combinations in all.

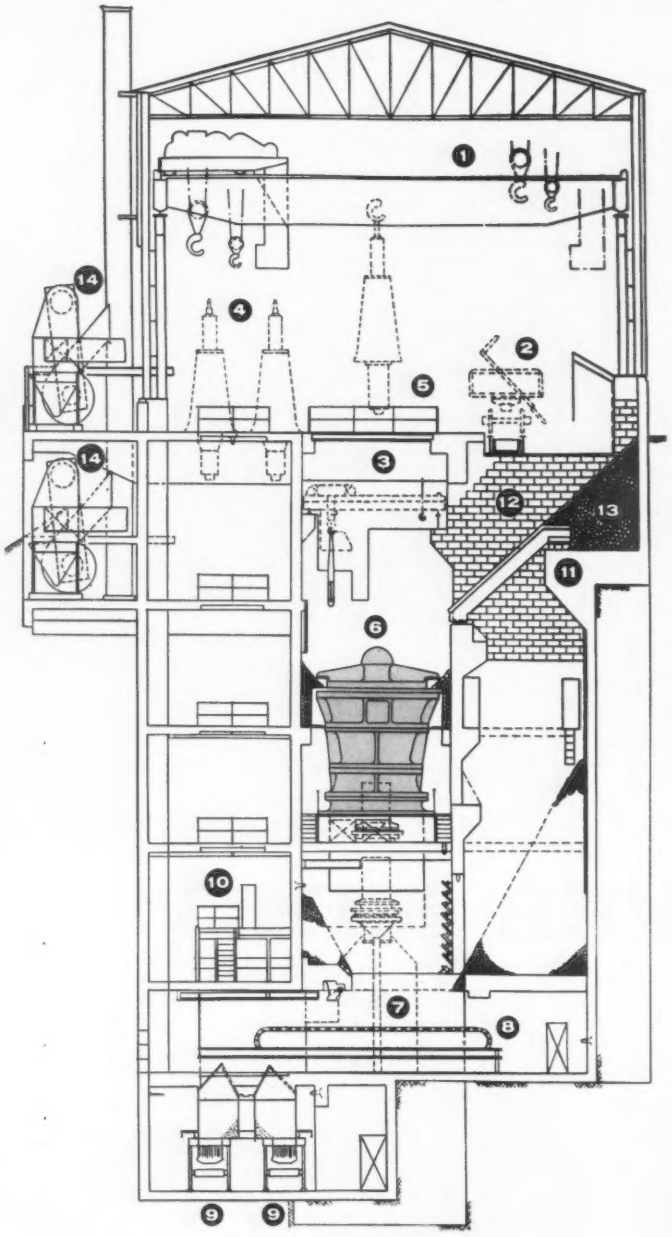
Now available in Persian Orange or Allis-Chalmers Yellow at no extra cost.

ALLIS-CHALMERS

. . . power for a growing world

1,000,000

POUNDS OF TRAYLOR ENGINEERING!



TRAYLOR

world's largest manufacturer of 60" gyratory crushers designed and built this giant for installation in Peru.

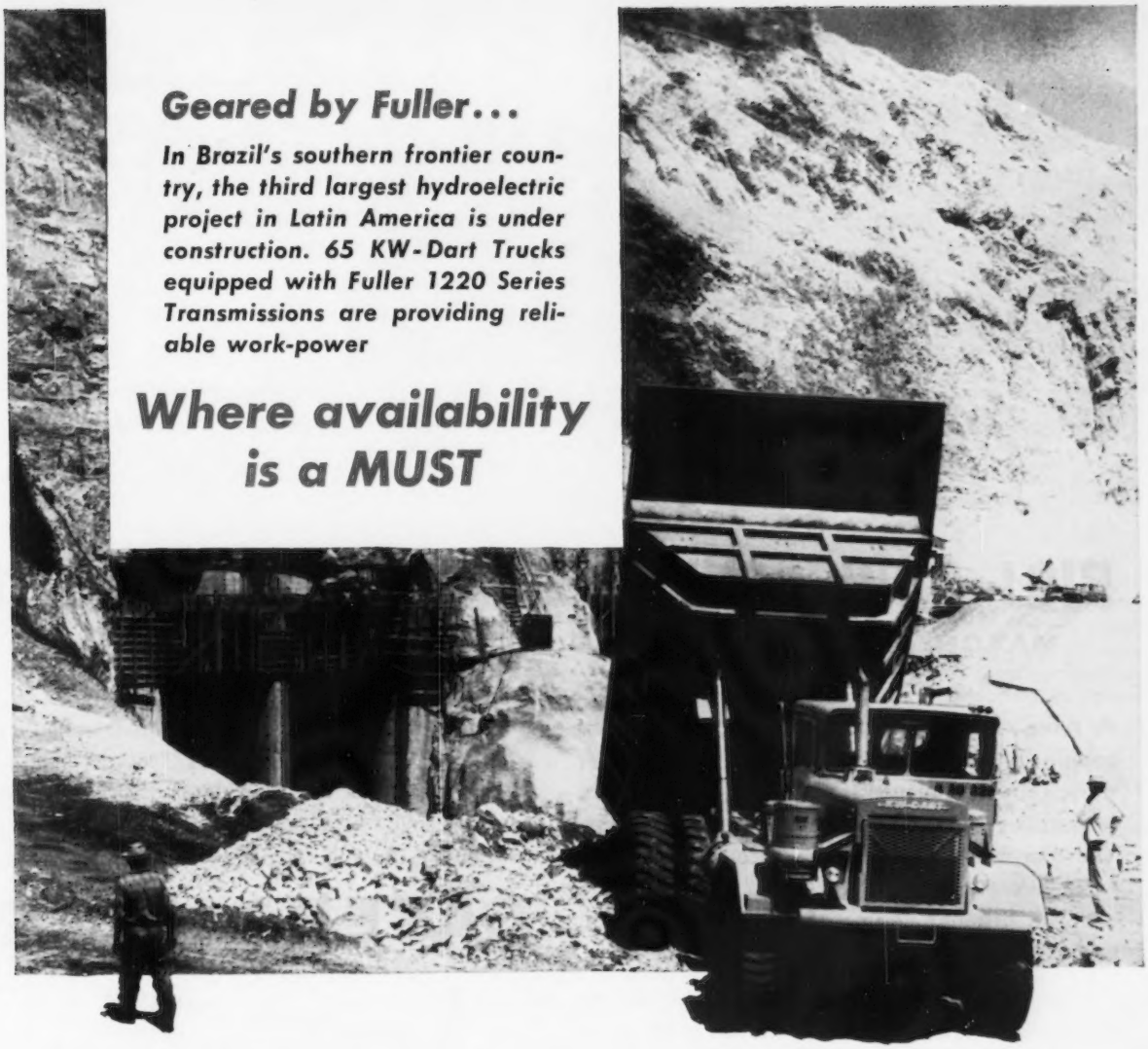
The Southern Peru Copper Corporation called on Traylor-made ECONOMY, EFFICIENCY, AND CAPACITY to handle the tremendous crushing workload at its new plant in Toquepala, Peru.

Drawing shows Traylor 60" gyratory crusher operation:

1. 100-ton crane with 25-ton auxiliary hook and operator's cab
2. 43-cu. yd. side-dump mine car
3. 20-ton crane with rock hook
4. Mantle storage
5. 18 x 22-ft. removable hatch
6. 60-in. Traylor gyratory primary crusher
7. Hydraulic hoist, 14-ft. lift, 25-ton capacity
8. Two 72-in. pan feeders
9. Two 54-in. chain-belt conveyors
10. Electrical control panel
11. 8-in. grizzly
12. 2-in. plate liners
13. Dead-bed areas
14. Air filter dust removal unit

Other Traylor Crushers made for primary, secondary or fine reductions. Write today outlining your crushing requirements and let Traylor's engineers make recommendations . . . or ask for Bulletin No. 1126.

TRAYLOR ENGINEERING & MANUFACTURING
DIVISION OF FULLER COMPANY
1553 MILL STREET, ALLENTOWN, PA.



Geared by Fuller...

In Brazil's southern frontier country, the third largest hydroelectric project in Latin America is under construction. 65 KW-Dart Trucks equipped with Fuller 1220 Series Transmissions are providing reliable work-power

Where availability is a MUST

To harness much of Brazil's tremendous water power potential, Central Eletrica de Furnas is building a 400-foot-high dam across the Rio Grande River. Completion date for the dam, which will create a reservoir 150 miles long, was originally set for 1965, but an earlier finish is now in sight.

Contributing greatly to the accelerated construction schedule are 65 Fuller-geared KW-Dart Trucks used on the project. 55 of the KW-Darts are Model 25SL, 25-ton dump trucks equipped with 320 hp diesel engines and Fuller 10-F-1220 10-speed Transmissions. The remaining ten are heavy-duty KW-Dart Diesel Tractors, seven of which are equipped with 10-F-1220s and the other three with Fuller 5-F-1220 5-speed Transmissions. The tractors are used to transport cement and move heavy equipment.

Working more than 6,000 miles from Kansas City, Mo., where they were built, the trucks were selected because of the dependability of their component parts. Reports from the project site indicate that the heavy-duty Fuller Transmissions in the mountain-moving fleet have been instrumental in the trucks' excellent record of performance and availability on one of the world's most dramatic construction jobs.

Ask about the Fuller Transmission designed for *your* operation.

FULLER TRANSMISSION DIVISION

EATON MANUFACTURING COMPANY

KALAMAZOO, MICHIGAN

Sales & Service: West. Dist. Branch, Oakland 6, Cal. • Southwest Dist. Office, Tulsa 3, Okla. • Automotive Products Co., Ltd., Brock House, Langham St., London W.1, England, European Rep.

NEW 631 420 HP (335 HP flywheel) . . . 31.2 MPH . . . 28 cu. yd. (21 cu. yd. struck).

NEW 630 420 HP (335 HP flywheel) . . . 41.5 MPH . . . 630A Tractor-Scraper . . . 28 cu. yd. (21 cu. yd. struck). 630-482C Tractor-Scraper . . . 35 cu. yd. (27 cu. yd. struck).

NEW ATHEY ROCK WAGONS
38 ton PR630 and PR631 built by Athey Products Corporation.

BIG! POWERFUL! NEW CAT 630 AND 631

MATCH POWER TO JOB CONDITIONS—AUTOMATICALLY!

A new concept in power shift transmission coupled with a new 420 HP engine . . . plus other proven new developments . . . provides the last word in operating, service, maintenance ease and economy. The four-wheel 630 and two-wheel 631 join the widely accepted DW20, DW21 and 619 to give you an even broader choice of hauling units from Caterpillar.

The new transmission and new engine on the 630 and 631 are designed and teamed to fit power to working conditions. This tailored power train, together with unit construction, greater scraper and wagon capacity, air-actuated cable control and new tires, makes the 630 and 631 the ultimate in hauling equipment design! Some of the features are described here. For complete proof of performance, ask your Caterpillar Dealer!

Caterpillar Tractor Co., General Offices, Peoria, Ill., U.S.A.

CATERPILLAR

Caterpillar and Cat are Registered Trademarks of Caterpillar Tractor Co.

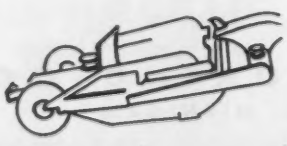
ADVANCED AS TOMORROW —CERTAIN AS YESTERDAY

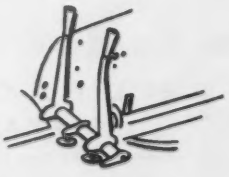
NEW 29.5 x 35 TIRES
This all-new tire size was originally developed for the 630 and 631, to provide the best combination of size, capacity and rideability at lowest cost per yard. These tires were proven by exhaustive laboratory and field tests.

NEW SCRAPERS
Matching 28 cu. yd. heaped (21 cu. yd. struck) scrapers feature increased capacity, better loading. Sheave bearings now have 125-hour lubrication period. Other matching trailed units are also available.

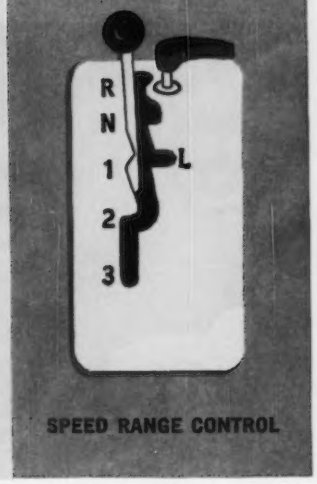
NEW CABLE CONTROL
Live power provides control whenever the engine is running. Air-actuated controls cut operator effort in half, yet retain "feel" of the control. New cable savers prevent breakage due to double-blocking.

IMPROVED STEERING
New two-jack steering makes the 631 easy to maneuver, yet retains "feel" of the road. Improved steering for the 630 absorbs shocks outside of the steering gear, provides easier handling in tight quarters.

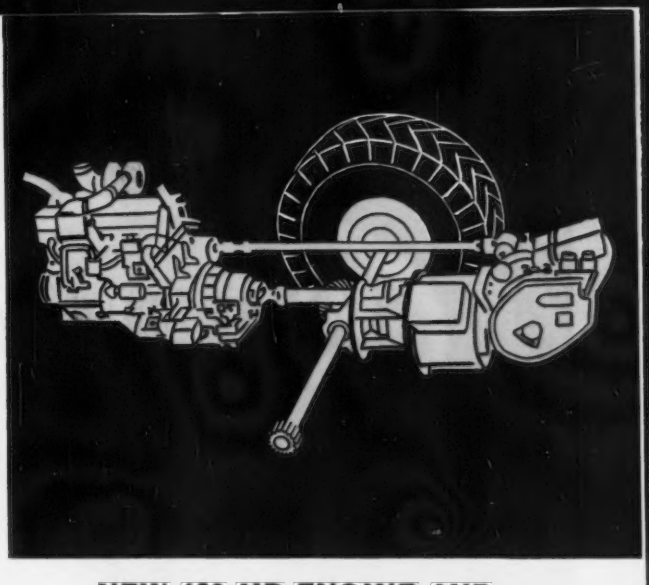




SHIFT INDICATOR



SPEED RANGE CONTROL



3 SHIFTS—9 SPEEDS

POWER SHIFT TRANSMISSION. This new concept in power shift transmission automatically adjusts the 630 and 631 to job conditions. Key to this system is the torque divider transmission mounted directly behind the engine, which combines planetary gears with a torque converter so as to provide power to the three-speed-range transmission in one of three ways: (a) torque divider drive (a combination of 75% direct, 25% torque converter); (b) direct drive; (c) overdrive. Result: nine different speed variations—*but* the operator need only concern himself with the three speed ranges and load range controlled by one lever. (A safety latch prevents accidental engagement.) The rest is completely automatic, governed by a mechanical-hydraulic system. Here's how it works:

Operator moves lever into *1*, first range, to start machine down haul road. The machine is now in torque divider drive for easy start and greatest rimpull. As speed increases, converter is no longer required, so the transmission shifts *automatically* to direct drive. When conditions permit, it automatically shifts to overdrive. As speed increases, the shift indicator dial shows operator when to shift to second speed range, *2*. Again the transmission automatically goes into torque divider drive. As before, when conditions permit, it automatically shifts to direct drive and then to overdrive. This same cycle can be repeated in third range.

NEW 420 HP ENGINE AND MATCHED POWER TRAIN

Downshifting is automatic, too. As transmission senses increasing power needs, it shifts down from overdrive to direct drive to torque divider drive. When conditions require it, the indicator tells the operator when to select the next lower speed range. Once back in the cut, operator shifts to load position, *L*. This locks the transmission in torque divider drive of the first speed range.

ALL-NEW CAT ENGINE. Designed specifically for the 630 and 631, this six-cylinder, 5.4″ bore x 6.5″ stroke D343 engine is turbocharged and aftercooled. It develops 420 HP maximum (335 HP at the flywheel).

Typical of the newness is head design. The engine is parallel ported with dual intake and exhaust valves for most efficient air system. Overhead camshafts eliminate rocker arms and push rods. New shelf head design results in fast coolant circulation for outstanding heat dissipation.

In addition to these and other new features, the engine offers . . . the economies of the proven Cat fuel system with precombustion chamber (burns No. 2 fuel oil—premium diesel fuel not required) . . . pressure ratio controlled turbocharger for optimum air flow throughout the engine operating range . . . aftercooler for greater air density for more complete combustion.

FULL UNIT CONSTRUCTION—EASIER SERVICING

TRANSMISSION UNITS

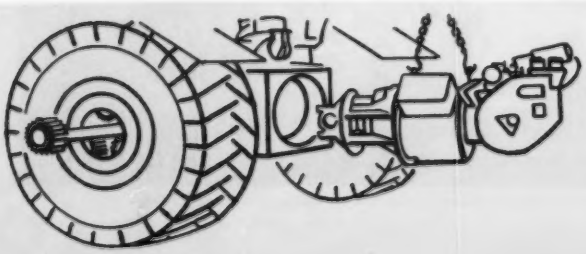
Range transmission is case mounted for accessibility, can be removed as a unit with cable control and differential carrier. Another timesaver: torque divider transmission is removable as a unit without disturbing the engine. Transmission control units are accessible without disturbing the transmission.

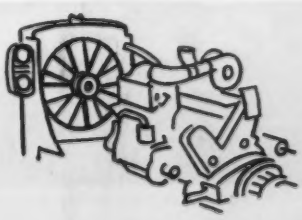
NEW RADIATOR-FAN UNIT

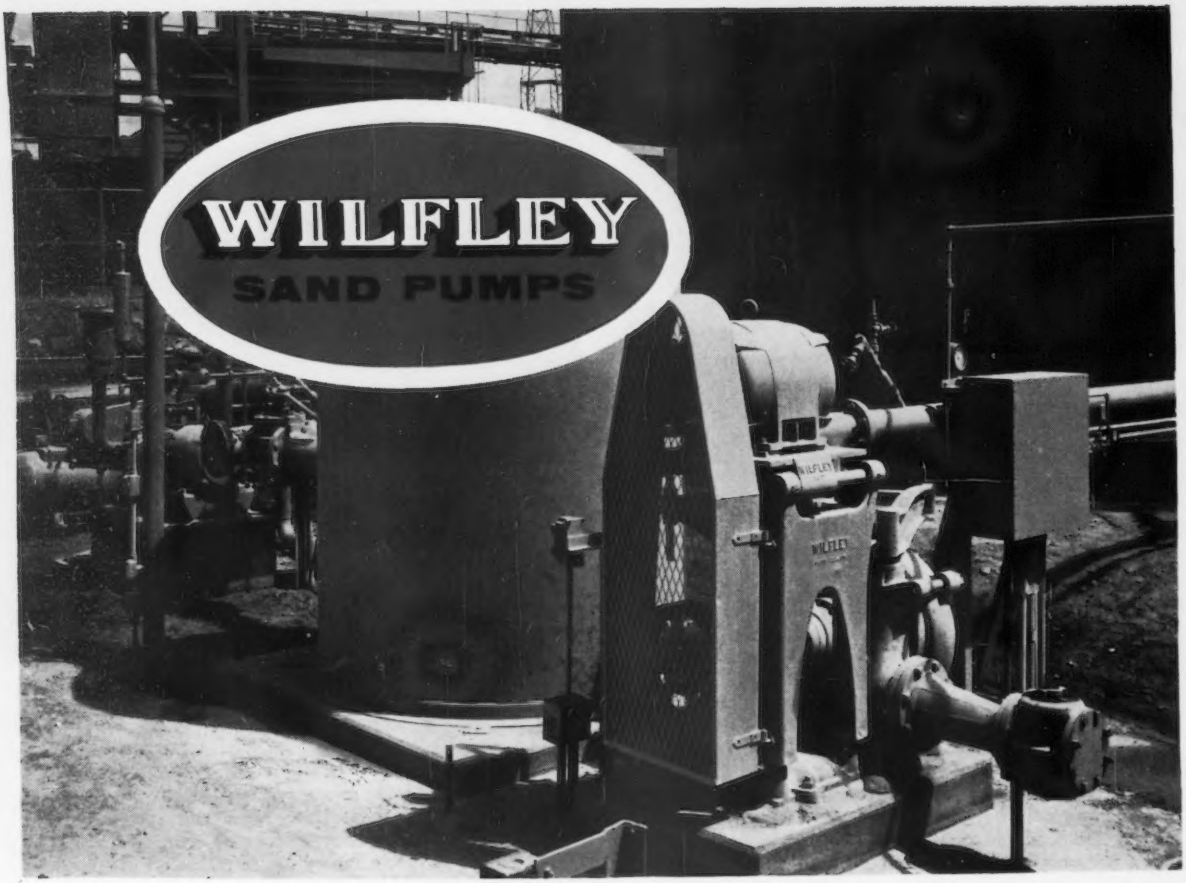
Fan is mounted on the radiator for more efficient cooling. Now radiator, side plates and fan can be removed as a unit for servicing—or to provide easy access to the front of the engine.

SERVICING TIMESAVERS

Dash swings away to expose entire left side of 631's engine. Crankcase guard pivots down for easy access to the bottom of the engine. For easy tire removal, rear fenders tip forward on the 630, and are easily removable on the 631.







Used The World Over

for Dependable, Low-Cost Pumping

This Hawaiian cement plant chose Wilfley Sand Pumps for their lower maintenance costs and higher operating efficiency. Wilfley's enviable reputation for true pumping economy and day-in, day-out dependability is reflected in the production records of plant operators throughout the world. Specify Wilfley for **your** next pumping job.

Wilfley Sand Pumps may be fitted with interchangeable electric furnace alloy iron, special application alloys or rubber-covered wear parts. Write, wire or phone for complete details.

Every Wilfley Installation Is JOB ENGINEERED

Wilfley Sand Pumps
"Companions in Economical Operation"
Wilfley Acid Pumps

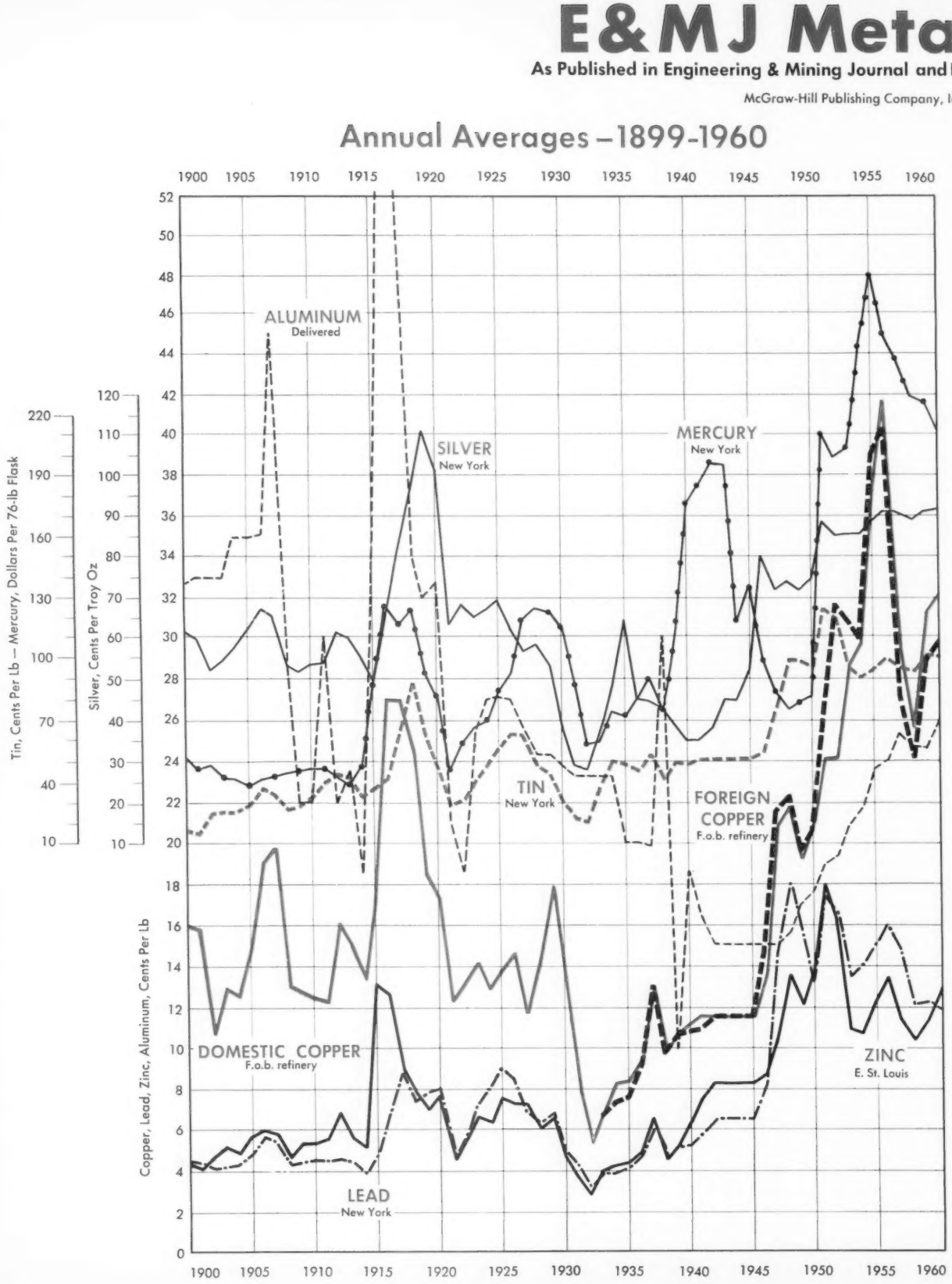
A. R. WILFLEY and SONS, Inc. Denver, Colorado, U.S.A. • P.O. Box 2330
New York Offices: 122 East 42nd St., New York City 17, N.Y.

E&MJ Meta

As Published in Engineering & Mining Journal and E

McGraw-Hill Publishing Company, In

Annual Averages – 1899-1960

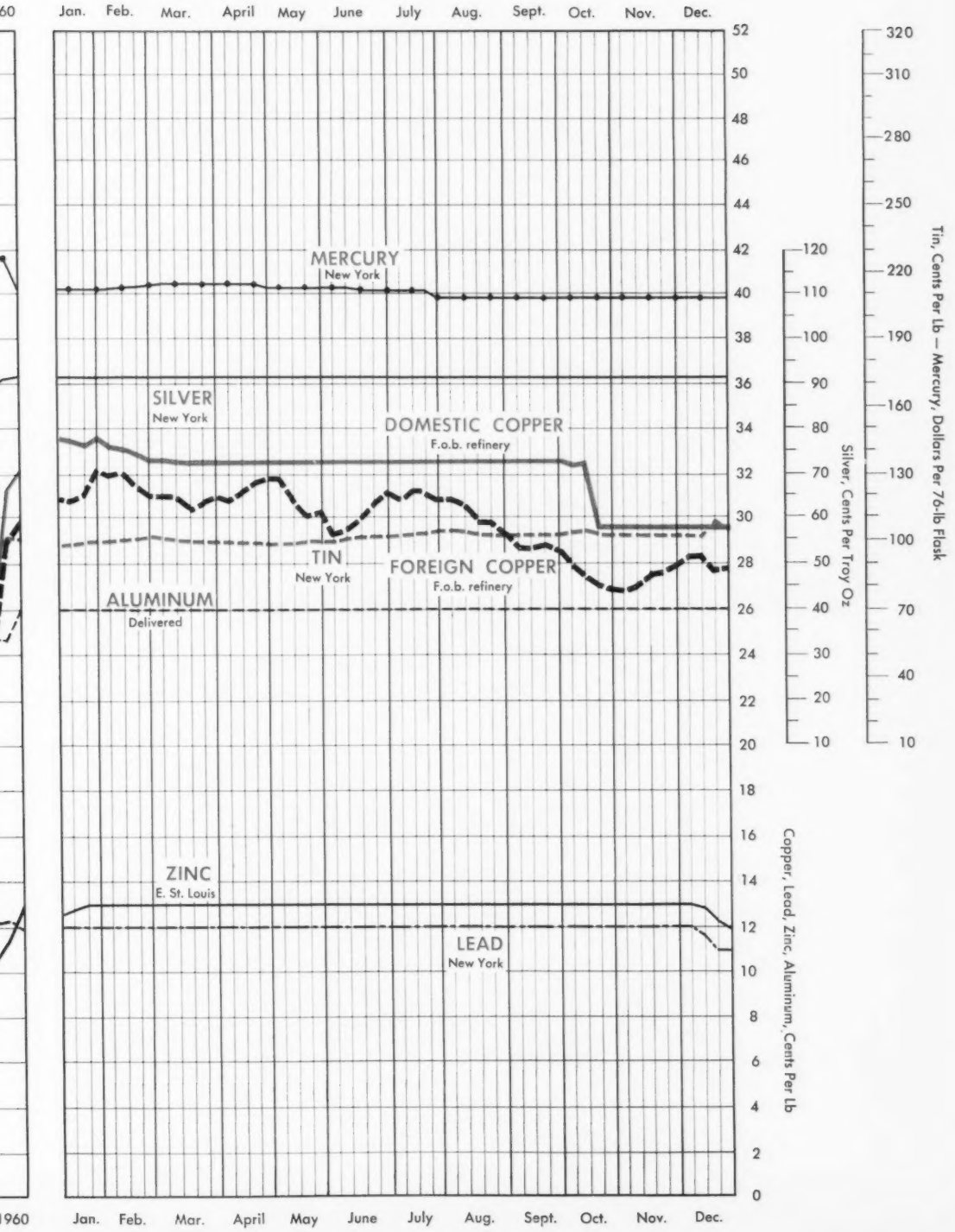


al Prices

and E&MJ Metal and Mineral Markets

any, Inc., New York

Weekly Averages – 1960



E & M J Annual Average Metal Prices—1898 to 1960

Year	COPPER (a) Domestic Refinery	COPPER Foreign Refinery	LEAD Common N. Y.	ZINC Prime Western (b) E. St. Louis	TIN (c) N. Y.	SILVER (e) N. Y.	MERCURY (f) N. Y.	ALUMINUM Ingot
1898	12.03	.....	3.780	4.570	15.70	58.260	40.70	30.58
1899	16.67	.....	4.470	5.750	25.12	59.580	43.63	32.72
1900	16.19	.....	4.370	4.390	29.90	61.330	51.00	32.72
1901	16.11	.....	4.330	4.070	16.74	58.950	47.00	33.00
1902	11.026	.....	4.069	4.840	26.79	52.160	48.03	33.00
1903	13.235	.....	4.237	5.191	28.09	53.570	41.32	33.00
1904	12.823	.....	4.309	4.931	27.99	57.221	41.00	35.00
1905	15.590	.....	4.707	5.730	31.358	60.352	38.50	35.00
1906	19.278	.....	5.657	6.048	39.819	66.791	40.90	35.75
1907	20.004	.....	5.325	5.812	38.166	65.237	41.50	45.00
1908	13.208	.....	4.200	4.578	29.465	52.864	44.84	28.70
1909	12.982	.....	4.273	5.352	29.725	51.502	46.30	22.00
1910	12.738	.....	4.446	5.370	34.123	53.486	47.06	22.25
1911	12.376	.....	4.420	5.608	42.281	53.304	46.54	30.07
1912	16.341	.....	4.471	6.799	46.096	60.835	42.46	22.01
1913	15.269	.....	4.370	5.504	44.252	59.791	39.54	23.64
1914	13.602	.....	3.862	5.061	34.301 (d)	54.811	48.31	18.63
1915	17.275	.....	4.673	13.054	38.590	49.684	87.01	33.98
1916	27.202	.....	6.858	12.634	43.480	65.661	125.49	60.71
1917	27.180	.....	8.787	8.813	61.802	81.417	106.30	51.59
1918	24.628	.....	7.413	7.890	88.750	96.772	123.47	33.53
1919	18.691	.....	5.759	6.988	63.328	111.122	92.15	32.14
1920	17.456	.....	7.957	7.671	48.273	100.900	81.12	32.72
1921	12.502	.....	4.545	4.655	29.916	62.654	45.46	21.11
1922	13.382	.....	5.734	5.716	32.554	67.528	58.95	18.68
1923	14.421	.....	7.267	6.607	42.664	64.873	66.50	25.41
1924	13.024	.....	8.097	6.344	50.176	66.781	69.76	27.03
1925	14.042	.....	9.020	7.622	57.893	69.065	83.13	27.19
1926	13.795	.....	8.417	7.337	65.285	62.107	91.90	26.99
1927	12.920	.....	6.755	6.242	64.353	56.370	118.16	25.40
1928	14.570	.....	6.305	6.027	50.427	58.176	123.51	24.300
1929	18.107	.....	6.833	6.512	45.155	52.993	122.15	24.300
1930	12.982	.....	5.517	4.556	31.694	38.154	115.01	23.787
1931	8.116	.....	4.243	3.640	24.467	28.700	87.35	23.300
1932	5.555	.....	3.180	2.876	22.017	27.892	57.93	23.300
1933	7.025	6.713	3.869	4.029	39.110	34.727	59.23	23.300
1934	8.428	7.271	3.866	4.158	52.191	47.973	73.87	23.300
1935	8.649	7.538	4.065	4.328	50.420	64.273	71.99	20.000
1936	9.474	9.230	4.710	4.901	46.441	45.087	79.92	20.000
1937	13.167	13.018	6.009	6.519	54.337	44.883	90.18	19.917
1938	10.000	9.695	4.739	4.610	42.301	43.225	75.47	30.000
1939	10.965	10.727	5.053	5.110	50.323	39.082	103.94	10.000
1940	11.296	10.770	5.179	6.335	49.827	34.773	176.86	18.691
1941	11.797	10.901	5.793	7.474	52.018	34.783	185.02	16.500
1942	11.775	11.684	6.481	8.250	52.000	38.333	196.35	15.000
1943	11.775	11.700	6.500	8.250	52.000	44.750	195.21	15.000
1944	11.775	11.700	6.500	8.250	52.000	44.750	118.36	15.000
1945	11.775	11.700	6.500	8.250	52.000	51.928	134.89	15.000
1946	13.820	14.791	8.109	8.726	54.544	80.151	98.24	15.000
1947	20.958	21.624	14.673	10.500	77.949	71.820	83.74	15.000
1948	22.038	22.348	18.043	13.589	99.250	74.361	76.49	15.733
1949	19.202	19.421	15.364	12.144	99.336	71.930	79.46	17.000
1950	21.235	21.549	13.296	13.866	95.539	74.169	81.26	17.713
1951	24.200	26.258	17.500	18.000	127.077	89.368	210.13	19.000
1952	24.200	31.746	16.467	16.215	120.473	84.941	199.097	19.410
1953	28.798	30.845	13.489	10.855	95.845	85.188	193.032	20.931
1954	29.694	29.889	14.054	10.681	91.838	85.250	264.386	21.784
1955	37.491	39.115	15.138	12.299	94.735	89.099	290.348	23.668
1956	41.818	40.434	16.013	13.494	101.409	90.826	259.923	24.032 (g)
1957	29.576	27.157	14.658	11.399	96.261	90.820	246.978	25.416
1958	25.764	24.123	12.109	10.309	95.127	89.044	229.057	24.790
1959	31.182	28.892	12.211	11.448	102.053	91.202	227.484	24.738
1960	32.053	29.894	11.948	12.946	101.438	91.375	210.760	26.000

(a) Lake copper 1897–98: domestic market since 1932. (b) New York delivery 1898–1902. (c) 99% in 1897 to 1920, inclusive: Straits quality thereafter. (d) Average for 11 months. (e) New York market. . . . All quotations in cents per lb, except for silver, which is in cents per troy oz, and (f) mercury, which is in dollars per flask of 76 lb. See opposite page and reverse for weekly average prices for 1960. (g) Unalloyed ingot beginning 1956.

E & M J Weekly Average Metal Prices—1960

	COPPER		LEAD	ZINC	TIN	SILVER	MERCURY	ALUMINUM
	Domestic Refinery	Foreign Refinery	Common N. Y.	Prime Western E St. Louis	N. Y.	N. Y.	N. Y.	99.5% unalloyed Ingot
Jan. 6	33.713	31.056	12.000	12.500	99.219	91.375	211.000	26.000
13	33.635	30.900	12.000	12.806	99.375	91.375	211.000	26.000
20	33.400	31.480	12.000	13.000	99.950	91.375	211.000	26.000
27	33.815	32.195	12.000	13.000	100.475	91.375	211.000	26.000
Feb. 3	33.385	32.045	12.000	13.000	100.400	91.375	211.000	26.000
10	33.255	32.485	12.000	13.000	100.725	91.375	212.000	26.000
17	32.950	32.820	12.000	13.000	101.438	91.375	212.000	26.000
24	32.694	31.455	12.000	13.000	101.531	91.375	213.000	26.000
Mar. 2	32.670	31.085	12.000	13.000	100.750	91.375	214.000	26.000
9	32.620	30.975	12.000	13.000	100.350	91.375	214.000	26.000
16	32.600	30.220	12.000	13.000	100.200	91.375	214.000	26.000
23	32.600	30.610	12.000	13.000	100.050	91.375	214.000	26.000
30	32.600	30.985	12.000	13.000	99.725	91.375	214.000	26.000
Apr. 6	32.600	30.780	12.000	13.000	99.625	91.375	214.000	26.000
13	32.600	31.205	12.000	13.000	99.375	91.375	214.000	26.000
20	32.600	31.675	12.000	13.000	99.625	91.375	214.000	26.000
27	32.600	32.830	12.000	13.000	99.200	91.375	212.000	26.000
May 4	32.600	31.835	12.000	13.000	99.100	91.375	212.000	26.000
11	32.600	30.695	12.000	13.000	99.175	91.375	212.000	26.000
18	32.600	30.015	12.000	13.000	99.600	91.375	212.000	26.000
25	32.600	30.180	12.000	13.000	99.725	91.375	212.000	26.000
June 1	32.600	29.210	12.000	13.000	100.094	91.375	212.000	26.000
8	32.600	29.456	12.000	13.000	100.850	91.375	212.000	26.000
15	32.600	29.880	12.000	13.000	101.275	91.375	211.000	26.000
22	32.600	30.650	12.000	13.000	101.600	91.375	211.000	26.000
29	32.600	31.125	12.000	13.000	101.750	91.375	211.000	26.000
July 6	32.600	30.865	12.000	13.000	102.438	91.375	211.000	26.000
13	32.600	31.210	12.000	13.000	102.625	91.375	211.000	26.000
20	32.600	31.165	12.000	13.000	103.425	91.375	211.000	26.000
27	32.600	30.855	12.000	13.000	104.725	91.375	209.000	26.000
Aug. 3	32.600	30.756	12.000	13.000	104.600	91.375	209.000	26.000
10	32.600	30.535	12.000	13.000	103.975	91.375	209.000	26.000
17	32.600	29.750	12.000	13.000	102.675	91.375	209.000	26.000
24	32.600	29.775	12.000	13.000	101.950	91.375	209.000	26.000
31	32.600	29.290	12.000	13.000	102.175	91.375	209.000	26.000
Sept. 7	32.600	28.655	12.000	13.000	102.438	91.375	209.000	26.000
14	32.600	28.650	12.000	13.000	102.325	91.375	209.000	26.000
21	32.600	28.760	12.000	13.000	102.025	91.375	209.000	26.000
28	32.600	28.520	12.000	13.000	102.250	91.375	209.000	26.000
Oct. 5	32.470	27.865	12.000	13.000	102.775	91.375	209.000	26.000
12	32.500	27.485	12.000	13.000	103.594	91.375	209.000	26.000
19	29.600	27.035	12.000	13.000	103.450	91.375	209.000	26.000
26	29.600	26.750	12.000	13.000	103.175	91.375	209.000	26.000
Nov. 2	29.600	26.765	12.000	13.000	103.325	91.375	209.000	26.000
9	29.600	26.995	12.000	13.000	103.313	91.375	209.000	26.000
16	29.600	27.580	12.000	13.000	102.938	91.375	209.000	26.000
23	29.600	27.645	12.000	13.000	102.825	91.375	209.000	26.000
30	29.600	27.920	12.000	13.000	102.219	91.375	209.000	26.000
Dec. 7	29.600	28.245	12.000	13.000	102.000	91.375	209.000	26.000
14	29.600	28.330	11.600	12.800	101.475	91.375	209.000	26.000
21	29.600	27.745	11.000	12.700	100.900	91.375	209.000	26.000
29	29.600	27.938	11.000	12.000	100.500	91.375	209.000	26.000

ENGINEERING AND
MINING JOURNAL

FEBRUARY 1961

Down-Beat on Gold Calls for Action

YOU CAN SCARCELY pick up any business publication, bank economic report or newspaper financial page today without finding a serious appraisal of the outflow of gold from the U.S. and what should be done about it. This issue was important enough to appear in the campaign talks of both political parties, and now commands a high priority for prompt consideration in the Kennedy Administration. The magnitude of this gold movement, its causes and possible remedies are reviewed factually by Dr. M. A. Kriz in his authoritative Gold Review on p 71.

Without going into detail, the mass of comment from the U.S. and abroad on this subject gives little hope for an immediate or near-by increase in the price of gold. But on the brighter side, it can be said that the importance of gold in domestic and international finance has seldom before been so thoroughly publicized. This suggests that if anything can be done to help the domestic gold producer, now is the time to do it.

As recommended in previous editorials, we suggest again that a subsidy on newly mined domestic gold will have the best chance for passage in Congress. Two resolutions of mining organizations during late 1960 supported this idea:

1. American Mining Congress recommended: That the "Government give immediate recognition to the increased costs of producing gold within the United States by means of an increase in the price paid to domestic producers of newly-mined gold."

2. A Northwest Mining Association resolution asks that "The Government give immediate recognition to the increased costs of producing gold within the U.S. by means of an increase in the price paid to domestic producers for newly mined gold."

We note also that Sen. Clair Engle of California proposes a bill which calls for an incentive allowance (subsidy of an additional $1 to $35 an ounce) to be paid to miners in addition to the regular Treasury price. It is further proposed that this subsidy should continue until the depletion due to gold outflow is made up and the U. S. reserves again amount to $23-billion.

An editorial in the Jan. 24 issue of THE WALL STREET JOURNAL promptly slaps down this proposal with the observation (1) That the proposed bill will do nothing to eliminate causes of the gold outflow including lavish aid commitments abroad and inflation at home (which is true of course) and (2) that with the subsidy, gold would "be pouring in the front door of Fort Knox at up to $70 an ounce; and streaming out of the back door, enroute to Europe, at $35 an ounce."

We doubt very much whether Sen. Engle would propose a bill so loosely drawn that it would permit $70 gold to leak out at $35 an ounce because such a bill would be unsalable to Congress. Secondly Sen. Engle has given commendable talks before mining audiences in Salt Lake City and elsewhere criticizing the mining industry for failing to frame legislation so that it would be readily acceptable to Congress.

In summary, then, the mining industry is in a strong position now to do something for the gold miner. But the sporadic efforts of various local groups sponsoring "back to gold" movements will have to be consolidated. And above all, we will have to quit asking for too much with the customary reward of getting nothing—and agree on more modest demands which will have at least a ghost of a chance of getting passed by Congress. We believe that a subsidy for domestic newly-mined gold can be sold to Congress for these reasons:

1. Such a subsidy will attract more gold to the U. S. Treasury without risking the devaluation damage to the dollar which a general price increase would entail.

2. It would go to the people who deserve it most —the energetic prospectors and miners who look for gold and dig it out of the ground.

3. Small mine operation is becoming a lost art because of low metal prices and high labor and material costs. A gold subsidy would send prospectors back to the hills, and encourage small operators to develop new deposits and open up others that are not now economic.

4. There is precedent for a subsidy in programs now in effect in Canada and Australia, and the domestic subsidies now applied to newly mined silver.

5. On a long range basis, there is a good chance that the price of gold will go up, particularly if all nations act in concert. In such event, subsidy outlays would be reimbursed.

But all of this is just so much idle speculation unless the divergent views on what should be done about gold mining are consolidated into some workable bill salable to Congress and to the public. Passing resolutions at mining meetings, or publishing reams of wishful thinking, are not going to be any more effective today than they have been during the past 25 years.

Major Metals

Dr. M. A. Kriz
The First National City Bank of N.Y.

U.S. gold stock dipped to lowest level since 1939. The rush, which last October swayed free gold markets abroad, abated near year's end. World production rose for the seventh consecutive year. p 71

Robert L. Ziegfeld
Secretary
Lead Industries Association

Lead situation worsened during 1960 —year-end price was lower, producers' stocks were higher and primary sales were substantially lower. Major consumers should use as much or perhaps more lead in 1961. p 77

George H. Cleaver
Manager of Market Research
American Metal Climax, Inc.

Copper can probably look forward to a quieter year in 1961 than it knew last year. There was dissatisfaction with some pricing bases; research and product promotion increased. p 91

J. R. O'Connell, Jr.
Market Editor
Engineering & Mining Journal

New International Tin Agreement, end of export controls and stability marked the 1960 tin market. Narrow price range with supply and demand in closer balance seen for 1961. Price changes unlikely. p 75

Irving Lipkowitz
Director of Economic Affairs
Reynolds Metals Co.

Aluminum faced tough inter-industry competition and greater resistance by other metals and materials to invasion of markets in 1960. New model automobiles continued to use more and more aluminum, and the major firms continued new market research. p 80

Dr. J. D. Hanawalt
Vice President
Dow Chemical Co.

Magnesium will show a slight gain for the year 1960 despite the business recession. Technical processes are improving, and wider applications are being found to compensate for the losses suffered in the cutback of military aircraft. p 79

A. W. Knoerr
Editor
Engineering & Mining Journal

U.S. steelmakers face intense competition in world markets. Federal and state governments, railroads, labor, and iron ore producers will have to make sacrifices to meet foreign market inroads. p 84

Charles R. Ince
Vice President & Sales Manager
St. Joseph Lead Co.

Zinc ended the year on a disappointing note, with both consumption and prices lower at year-end than they had been in January. Sheet and strip galvanizing provided a bright spot, and second half 1961 should see better consumption. p 82

Francis H. Wemple
Treasurer
Handy & Harman

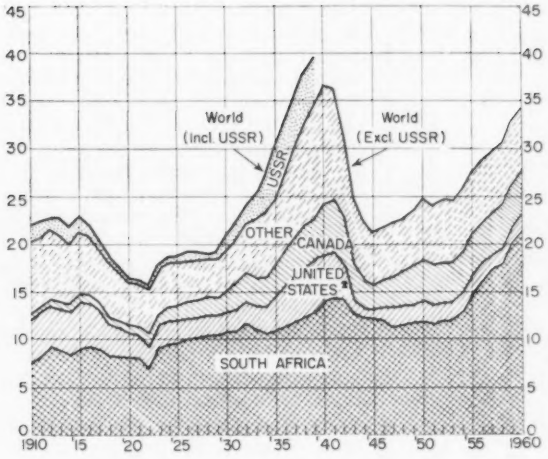
Silver prices were steady and demand was strong in world markets in 1960. Price stability is expected for the short term, and higher price levels can be expected in the long term. p 86

Robert W. Bernick
Financial Editor
The Salt Lake Tribune

Uranium in the U.S. and abroad started a "shakeout" following announcement of AEC's revised commitment estimate. The Commission has finished negotiation of 17 of the 27 mill contracts. p 88

World Gold Production

(Millions of fine oz)



	1960*	1959	1958	1957	1945	1940
North America:						
Canada	**4.6**	4.5	4.5	4.4	2.7	5.3
United States	**1.7**	1.6	1.8	1.8	0.9	4.9
Latin America:						
Mexico	**0.3**	0.3	0.3	0.4	0.5	0.9
Colombia	**0.4**	0.4	0.4	0.3	0.5	0.6
Chile	**0.1**	0.1	0.1	0.1	0.2	0.3
Nicaragua	**0.2**	0.2	0.2	0.2	0.2	0.2
Africa:						
Union of South Africa	**21.4**	20.1	17.7	17.0	12.2	14.0
Ghana	**0.9**	0.9	0.8	0.8	0.5	0.9
Southern Rhodesia	**0.6**	0.6	0.6	0.5	0.6	0.8
Congo	**0.3**	0.3	0.4	0.4	0.3	0.6
Asia:						
India	**0.2**	0.2	0.2	0.2	0.2	0.3
Philippines	**0.4**	0.4	0.4	0.4	—	1.1
Australia	**1.1**	1.1	1.1	0.1	0.7	1.6
Total	**32.3**	30.8	28.4	27.6	19.5	31.6
Other, excluding USSR	**2.0**	2.0	2.0	2.0	1.6	5.1
World, excluding USSR	**34.3**	32.8	30.4	29.6	21.1	36.7

*Tentative figures based on preliminary data. Note: Figures may not add up to totals because of rounding.

Gold

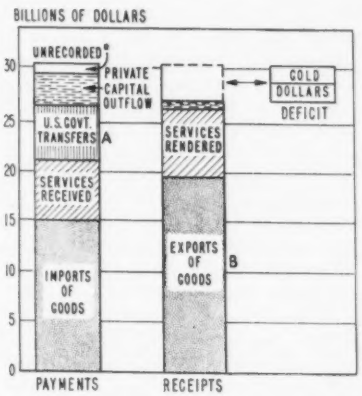
Dr. M. A. Kriz

THERE IS more interest in gold today than at any time during the past quarter century. The U.S. gold stock, so long the symbol of the impregnable position of the dollar, has declined to its lowest point since 1939. At the same time, the large gold purchases by Western European countries — from U.S. reserves as well as from new output—attest to the prestige the metal commands among governments and central banks. Uses of gold in industry and the arts, including some entirely new industrial applications, have increased considerably. The widely publicized gold rush, which swayed the free gold markets abroad last October, abated toward the year end; but some feeling of suspense will persist until the new U.S. Administration offers concrete evidence to support its firmly expressed intention to defend the present value of the dollar and its soundness.

World gold production rose in 1960 for the seventh consecutive year. At some 34.3-million fine oz (excluding output in the USSR), it was about 5% higher than in 1959. Gold output last year was 13.2-million oz above 1945, the postwar low, but still 2.4-million oz short of 1940, the all-time high (see table and chart).

As in each year since 1953 when the current phase of expansion in world gold output began, the rise in production was due basically to the increase in South Africa. At some 21.4-million oz, South African production was 6% above the previous year. Last year's output was some 7-million oz above 1941, the peak year of the expansion that began after the currency devaluations in the 1930's.

The new gold mines in the Orange Free State continued to increase production, which exceeded 6-million oz during 1960, up more than 10% from the corresponding period of 1959; 10 years ago, production there was negligible. There was also some rise in the output of the Transvaal mines. The increase in South African production is expected to continue for the next few years as many of the newer mines expand their capacity.



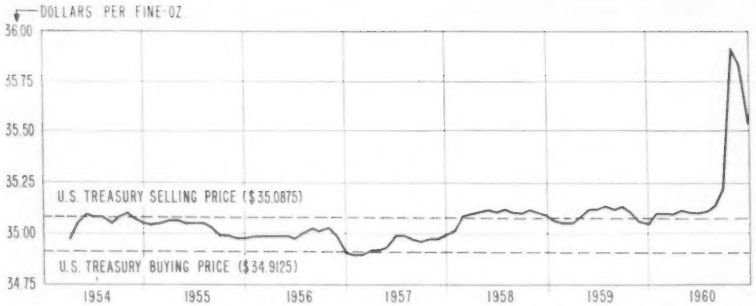
U.S. BALANCE OF PAYMENTS for 1960 are footnoted as follows: *Unrecorded payments, presumably reflecting mainly short-term capital outflows; A—Military expenditures abroad, economic grants, and loans (net); B—Excluding shipments of military goods financed through defense aid.

South Africa accounted for almost two thirds of the world gold output (excluding the USSR). Elsewhere, production remained, on the whole, stationary. In Canada, output rose slightly; it has fluctuated during the past seven years within a range of 4.4- to 4.6 million oz.

In the U.S., according to preliminary reports, production rose about 3% in 1960 to 1.7-million oz. The downward production trend of the preceding four years was thus reversed. Last year's output was still more than 10% below 1955.

Russia's gold output continues to be blanketed in secrecy. Western observers put it at 10- to 17-million oz annually, which would make the Soviet Union the second largest gold producer. We are less in the dark regarding the gold Russia sells in Europe to balance its international accounts. Gold import statistics of other countries show that the USSR exported some 7-million oz annually during 1957-59. In 1960, however, gold imports from Russia were apparently running at half the rate of 1959.

Mining costs are a matter of great concern for an industry which must work at a fixed price for its product. In South Africa working costs per ton milled, which declined in 1959, rose again last year; but in terms of gold produced, costs declined—for the second year in succession (see table). The yield per ton of ore milled rose by 6%; this increase, together with a further expansion in native labor force, was the main factor behind the rise in output.



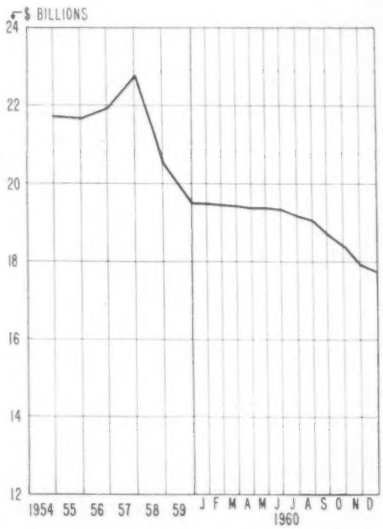
THE DOLLAR EQUIVALENT OF THE LONDON GOLD PRICE zoomed drastically from the U.S. Treasury price to $35.93 (monthly average) in October.

Profits of the South African gold industry rose last year for the seventh consecutive year. Total working profits from gold during the first nine months of 1960 reached the record high of $202-million; those from gold and uranium combined amounted to $264 million—up 12% from the previous year.

The high dividend yields during recent years as well as the generally favorable tax status accorded by South Africa to foreign investors encouraged new investment in gold mining. Since World War II, about $1.3-billion has been invested in the gold and uranium industry; of this amount, some two fifths has come from outside the Union. Political unrest last year, however, caused some withdrawal of foreign capital from the South African gold industry.

Subsidies continued to be paid to gold producers in Australia, Canada, Colombia, and a few other countries. In Canada, the subsidy program was extended until the end of 1963. Such subsidies in these and certain other countries are designed to benefit marginal producers, the amount of subsidy being related—with the approval of the International Monetary Fund—to economic needs of various categories of mines, and subject to a number of conditions.

Industrial uses of gold in the U.S. have been expanding in recent years. In 1959 (latest figures available), such uses rose to 2.5-million oz (net, i.e. after recoveries from scrap), compared with 1.8-million in 1958 and 1.3-million in 1955; they thus exceed the current U.S. gold output, the difference being made up by releases from monetary stocks. In addition to traditional uses in jewelry, gold articles, and dental and other supplies, some entirely new industrial applications have been developed in recent years. Among these are protective and decorative coatings on ceramic materials and metals; gold coatings are being applied, for example, on missile and aircraft sections to reflect infrared.



U.S. GOLD STOCKS continued their downward trend, hitting $17.767-billion at month-end, December.

Private demand abroad rose in 1960. Although data for the year as a whole are not yet available, there are indications that additions to official gold stocks from current output were curtailed. During each of the first two quarters of 1960, such stocks rose by $190-million; for the third quarter, the increase was $140-million. It is doubtful that any amount to speak of was added to the year's total during the fourth quarter.

During the latter part of last year, private demand increased with the rumor—since firmly denied—that a new U.S. Administration might act to devalue the dollar. As a result, in October 1960 the price of gold in London broke out of its established trading range around the official U.S. price of $35. It rose to $40 on Oct. 20 but following this flare-up it settled down to a monthly average of $35.85 in November and $35.54 in December (see chart). In mid-January, it moved up to $35.80 but subsequently fell below $35.50.

Some of the increased private demand for gold was for American accounts. As is well known, the regulations in force for a quarter of a century prohibited the holding of gold by Americans in the United States (except for gold dust and coins of recognized numismatic value), but not the holding abroad; this loophole was plugged by a Presidential order issued on January 14. This move was subject to considerable criticism, partly on the ground that it was taken in isolation as a piecemeal step, partly because of difficulties of enforcement.

As private demand for gold outran offerings from current production, gold sales were made on the London market from the British reserve to bring the price down to a somewhat more normal level. According to market comments, official intervention was conducted under a broad understanding with American authorities that the British could replenish in New York gold used to keep the London market under control.

Unrest in Africa and certain parts of Latin America and Asia, and concern over the world political situation also contributed to the enlarged private demand for gold.

More gold thus found its way into private hands in 1960 than had been true for several years (see table). Reasonable stability—political as well as financial—must unquestionably be maintained if gold is to flow into official monetary stocks in amounts as large as in the late 1950's.

Today, many countries allow free gold markets and domestic holdings of gold; however, only a few countries—Germany and Switzerland, for instance—allow their nationals to export gold freely. In the United Kingdom, British and other sterling-area residents are not permitted to buy gold, except for licensed uses in the arts and industry; only residents of nonsterling countries may buy gold in London—against U.S. dollars and other convertible currencies.

Official gold stocks of foreign countries increased not only as a result of purchases of newly mined gold but also because of large purchases of gold from the U.S. In the first half of 1960, the decline in the U.S. Treasury's stock amounted to only $134-million; but it rose to $637-million in the third quarter and to $918-million in the fourth quarter. The total decline in the U.S. stock amounted, therefore, to $1,689-million compared with $1,078-million in 1959 and $2,247-million in 1958, the heaviest annual gold loss in American history.

Changes in Monetary Gold Stocks of Selected Foreign Countries

January 1958-September 1960
(Millions of dollars)

	Through transactions with: U. S.	I.M.F.*	Other†	Gold stock Sept. 30, 1960
Germany	$ 0	$−114	$ 461	$2,889
United Kingdom	1,450	−163	−212	2,675
Italy	349	− 68	1,453	2,186
Switzerland	355	0	− 81	1,980
France	322	− 66	790	1,627
Netherlands	436	− 34	200	1,346
Belgium	426	− 28	−219	1,094
Canada	0	− 63	−143	894
Portugal	30	0	59	550
Venezuela	− 65	0	−193	462
Austria	168	− 6	28	293
Japan	187§	− 63	97§	244§
All foreign countries	3,803	−1,052	2,160	19,434

*Gold payments to the I.M.F. on account of capital subscriptions. †Residual figures; including gold acquired from new production, Russian sales, etc. §Through June 30, 1960 Additional $15 million of gold was purchased from the United States in the third quarter of 1960.

Estimated Sources and Uses of Gold

(Millions of dollars)

	Gold production*	Reported sales by USSR	Increase in official stocks*	Industrial uses and additions to private holdings†
1951	826	...	210	616
1952	850	...	250	600
1953	848	75	470	453
1954	897	75	650	322
1955	940	75	680	335
1956	978	150	480	648
1957	1,017	260	720	557
1958	1,049	220	665	604
1959	1,125	250	680	695
1960	**1,180**	**n.a.**	**520‡**	**n.a.**

*Excluding USSR etc. †Residual figures. ‡Jan.-Sept. n.a.—Not available.

To help trace the origin of changes in foreign monetary gold stocks during the past three years, the accompanying table shows purchases from the U.S. Treasury, gold payments to the International Monetary Fund on account of capital subscriptions, and all other transactions, including acquisitions of newly mined gold. In the aggregate, foreign countries added almost $6-billion of gold during January 1958—September 1960, of which $3.8-billion came from the U.S. and $2.2-billion from other sources; furthermore, the Fund increased its gold holdings by over $1-billion.

Large gold buyers from the United States included the United Kingdom, the Netherlands, Belgium, Switzerland, and Austria—and also Japan. Italy and France made most of their gold purchases in the London market or elsewhere; Germany has bought no U.S. gold since early 1955.

Beginning in the third quarter of 1960, with strengthening private demands driving up the London price, official gold buying shifted more and more to the U.S. Treasury, which sells at a fixed price of $35.0875 per fine oz ($35 plus ¼% handling charge); with the price rise in the last quarter, central bank buying in London ceased altogether.

Only dollars held by foreign governments and central banks may be used to purchase gold from the U.S. Such dollars have, in the aggregate, continued to increase; at the end of October, they stood at $10.3-billion —$1.1-billion more than at the end of 1959. Holdings of individual central banks are not made public by the U.S. Treasury; but from balance sheets of foreign central banks it appears that Germany has retained a sizable part of the aggregate increase in official foreign dollar holdings, while most other banks have used newly acquired dollars to buy gold.

The gold transfers to the International Monetary Fund noted above were made in payment of the gold portions of capital subscriptions which were enlarged in 1959. Frequently, foreign nations purchased gold from the U.S. Treasury to make these payments. The United States itself initially transferred to the Fund $688-million of gold in 1947, and a further $344-million in 1959, in payment of the gold portion of its own subscription. Additional amounts moved from the U.S. to the Fund as other nations purchased gold from the U.S. to repay in gold, as required by the Fund statutes, part of their currency drawings.

A substantial part of the Fund's gold was returned to the U.S. Treasury. During the past five years, the Fund sold back $600-million to the Treasury to replenish its dollar resources and $800-million to purchase U.S. Treasury bills and thus gain earning assets. Of these transactions, $600-million were carried out during the 1958-60 period of drain on the U.S. gold stock—$300-million in the second half of 1959, and $300-million in December 1960. In connection with its conversions of gold into Treasury bills, the Fund received assurances that the Treasury would resell the gold to the Fund at short notice, if requested.

The U.S. gold position thus weakened further in 1960. At the end of the year, the U.S. gold stock—$17,767-million—equaled about 45% of the world's monetary gold stock (excluding Russia), approximately the same proportion as in the late 1920's. In 1949, when the U.S. gold stock was at its peak, the proportion was 70%.

In broader perspective, monetary gold reserves held outside the U.S. (and outside Russia) stood, at the end of 1960, at some $23-billion—more than twice as high in December 1949. Of this $12-billion increase, close to $7-billion came from the U.S. and the remainder from new gold output, Russia, and other sources. At the same time, foreign countries added over $12-billion to their short-term dollar banking assets, which reached some $18-billion. Altogether, therefore, foreign gold and dollar holdings, now at some $40-billion, have increased about $24-billion in the past eleven years. Most of this improvement in foreign reserves has been concentrated in Continental Europe (especially German, Italy, and France) and Japan.

The reason for the gold and dollar outflow is the deficit in the U.S. balance of payments that has prevailed for most of the past decade. At first, the gold and dollar outflow relieved —and then reversed—the postwar dollar shortage. The United States helped the Western European nations by extending economic aid, encouraging imports from them, and tolerating discrimination against its own exports. Most European countries, having corrected the over-evaluation of their currencies in 1949, succeeded in raising output and productivity and in restoring fiscal and monetary order. As a result, the dollars supplied by the U.S. enabled them to rebuild monetary reserves and gradually to

Basic Operating Statistics of South African Gold Mines

	1950	1955	1958	1959	Jan.-Sept. 1959	Jan.-Sept. 1960
Ore milled (Millions of tons)	59.5	66.0	65.5	70.5	52.8	**53.5**
Yield per ton milled (dwt)	3.76	4.27	5.23	5.57	5.51	**5.84**
Working costs:						
$ per ton milled	4.14	5.66	6.57	6.35	6.32	**6.49**
$ per oz. of gold	n.a.	n.a.	25.03	22.74	22.89	**22.16**
Working profits:						
$ per ton milled	2.43	1.88	2.64	3.44	3.36	**3.80**
Total ($ Millions)	144.2	124.0*	171.8*	241.0*	176.4*	**202.3***
Dividends ($ Millions)	69.2	62.7	121.5	129.3	87.2	**91.8**

*Excluding profits from uranium production, which amounted to $49.3 million in 1955, $105.7-million in 1958, $76.3-million in 1959, $57.1-million in Jan.-Sept. 1959, and $57.8-million in Jan.-Sept. 1960.

Note: All dollar amounts have been converted from South African pounds at the rate of £1 = $2.80.

restore convertibility and multilateral trading.

Over the past three years, however, the build-up of monetary reserves abroad has entailed balance-of-payments deficits of a size that the United States cannot afford to run indefinitely. In 1960, the deficit amounted to $3.5-billion (see chart), about the same as in 1959 and 1958. Approximately one half of the 1960 deficit was taken out in gold and one half in dollars. As a result of the gold outflow in 1960 and a further rise in short-term liabilities to foreigners, our net short-term indebtedness abroad (after deducting our private short-term claims on foreigners) exceeded the U.S. gold stock.

The gold and dollar outflow does not stem from a merchandise trade deficit. Last year, the surplus of our commercial merchandise exports over imports stood at some $4.5 billion—exceeded in the past decade only in 1956 and 1957; in 1959, the surplus was down to $0.9-billion. The rise in our trade surplus reflected principally an increase in exports from 1959's $16.2-billion to $19.5-billion (due, in part, to special or temporary factors).

The trade surplus, augmented by income derived from investments abroad and other current receipts (net), was more than offset, however, by U.S. Government outlays abroad and private capital outflows. U.S. Government military expenditures abroad, economic aid, and loans ran at somewhat over $5.5-billion in 1960. Long-term private capital outflows totaled some $2.5-billion. Unlike military expenditures and foreign aid, however, private investments abroad bring a return flow of dollars: remitted earnings have since 1958 been greater than the outflow of new long-term private funds. This remitted income buttresses our balance of payments.

During 1960, particularly in the third quarter, private capital outflows, normally of a long-term investment character, were enlarged by movements of short-term funds. Because of differences in inflationary pressures—which weakened in the U.S. and strengthened in Europe—short-term interest rates fell substantially in the U.S. and rose in the United Kingdom and Germany; these rate differentials, together with a further strengthening of European currencies, induced sizable outflows of U.S. short-term funds. Of less quantitative importance—but of potential concern—was an element of speculation that the dollar might be heading for a devaluation, as already noted.

The short-term fund outflows have resulted in an accumulation of valuable claims on the United Kingdom and other countries. Furthermore, such flows of funds are reversible, since interest differentials vary with changing business conditions and monetary policies here and abroad; these differentials did, in fact, decline toward the year end. The best way for a country to cope with short-term fund movements is to ensure that it has ample reserves and pursues proper monetary policies. To clap direct controls over capital movements would be a step backward from the much better integrated international money market that has come into existence over the past two years. Besides, as the European experience has shown, controls on capital movements cannot be effectively imposed without subjecting to control all other payments, including those for merchandise imports and services.

In brief, the U.S. is in trouble because our present level of exports of goods and services is insufficient to cover our imports plus our military expenditures abroad, plus our programs of foreign aid, plus the long-term investment abroad and the short-term capital outflows that have been taking place recently.

Restoring a better balance depends in part on our own policies and in part on the policies of countries whose balance-of-payments surpluses are the counterpart of our deficits.

The United States has taken a number of direct steps to reduce the payments deficit. From now on, U.S. cash military expenditures in Germany and other countries will be curtailed and our foreign aid will be increasingly tied to purchases of American goods. This practice, initiated in a limited fashion over a year ago and strengthened last November, runs against the grain of multilateralism advocated by the U.S. over the past quarter century, but under present-day circumstances is a regrettable necessity.

These and other measures will undoubtedly help. At the same time, however, it remains essential that we strengthen our ability to supply goods and services at competitive prices. Above all, the policies of the new Administration will have to be designed to reassure foreign holders of dollars as well as Americans themselves that conditions will not develop under which a devaluation of the dollar would appear to be inevitable.

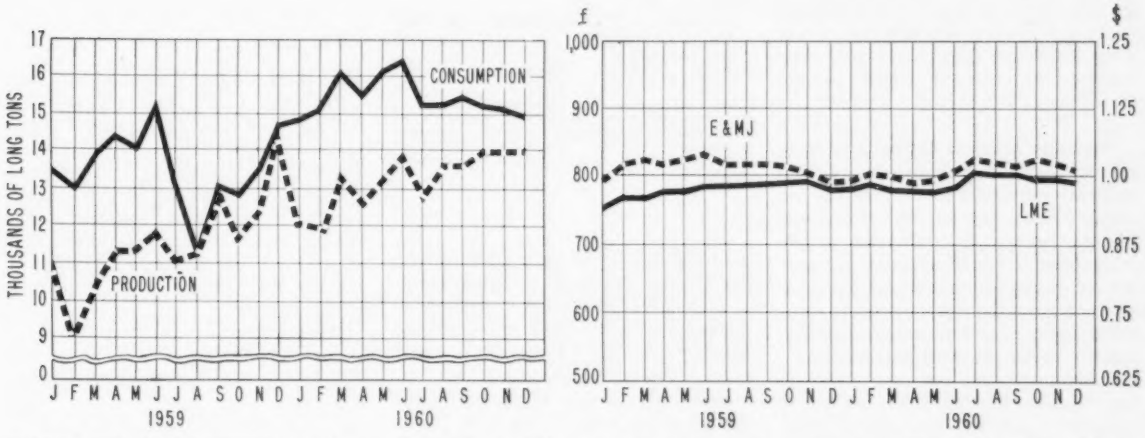
This does not mean that the U.S. has insufficient latitude in using monetary and fiscal policies to help overcome the present business recession. But we will need to exercise more discretion than at some times in the past in the use of economic stimulants. Specifically, we can no longer afford to carry cheap money to extremes or to loosen the reins on government spending. We must find fiscal policies, such as tax reforms, which can check recessions and stimulate creative effort and growth without opening the floodgates to inflation.

The countries that have surpluses with the U.S. must also take measures to balance their international accounts. Now that our European allies are much stronger, they will be able to contribute more to the common defense and the development of poorer nations.

Moreover, the United States can legitimately press other nations to end what discrimination remains against American goods and to reduce tariffs, which in many countries are much higher than in the U.S. The United States is also urging Europe to remove the danger of discrimination against outsiders, including the U.S., implied in the European Common Market and the Free Trade Assn.

These and other measures to deal with the international financial imbalance will be taken, it must be hoped, without weakening the defense of the Free World, without impairing the economic development of Asia, Africa, and Latin America, and without adversely affecting world trade and the free flow of funds connected with it.

The present gold problem thus reduces itself to dealing with the U.S. payments deficit, and the payments surpluses of Germany and other European nations, through means that will enlarge the flow of international trade and investment. Trade restraints, controls on capital movements, and devaluation are no remedy. Nor can the U.S. international position be strengthened merely by steps designed to remove the threat of a run on our gold by guaranteeing against devaluation all dollar balances in the hands of foreign monetary authorities or by establishing an international super-central bank. The fundamental task we face is to recreate conditions, in the main trading nations and in the world at large, under which the present international imbalance will be redressed. After the remarkably successful postwar economic and financial reconstruction, this task is perhaps less formidable than it appears; but it will have to be tackled promptly, courageously, and responsibly. END



WORLD TIN CONSUMPTION again exceeded output in 1960. A trend toward improved balance is indicated in the graph on the left, in thousands of long tons. The graph on the right in dollars and pounds shows the extreme price stability of 1959-60.

Tin

J. R. O'Connell Jr.

TIN, THE ONLY MAJOR METAL whose price is subject to international control, remained warmly under the wing of the International Tin Agreement in 1960, exhibiting extreme stability and generally reacting as forecasters predicted a year ago.

Stringent export quotas posted by ITA on producing members in 1959 helped lift N.Y. prices 7¢ a lb on a yearly average basis to $1.02 from 95¢ recorded in 1958. There was little change in 1960. The N.Y. price was lower by 0.7¢ a lb over the year, registered a low of 99.5¢ in May and a peak of $1.035 in July. It appears that a price level of $1 to $1.02 is satisfactory to ITA powers; and, like it or not, consumers are probably safe in figuring on a similar posting in 1961.

Several events of the year made news but were neither earthshaking nor unexpected. The Tin Agreement was eminently successful in 1959 in liberalizing quotas, cutting stocks and holding prices up through the extended U.S. steel strike. Solidly entrenched in 1960, there was little doubt that a new agreement would be drawn up. It needs now only to complete ratification to become effective in July of this year. The cartel has become so much a part of the tin picture that one reviewer was prompted to refer to the market in the present quarter as a free one.

Abandonment of export quotas in the last quarter of the year, a policy which was renewed for the first quarter of 1961, made the biggest news. A gradual easing of restrictions in 1959 tipped off the possibility, but, nevertheless, observers here were taken by surprise.

Tin's statistical position was given as a reason for the quota cutoff. With the exception of Malaya, producing countries under liberal quotas for the second and third quarters were producing close to capacity. At various times several producers—notably Bolivia—had failed to reach their quota limits. World stocks had been dented; The Congo was raging, with its tin output in doubt; U.S. demand had perked up; and European call continued strong. A shortage of spot material had developed in Europe. Without restrictions, it was felt that those countries capable of producing more and drawing upon stocks—particularly Malaya—would be able to supply the added metal. Even though the world surplus had neither been cut as deeply nor as quickly as had been predicted, immediate world demand would be satisfied, ITA administrators said. Producing countries, who in the past had oversupplied the market, were expected to be restrained by the threat of the reimposition of quotas. Cancellation of quotas was considered preferable to reallocation of export percentages.

The beginning of the year was marked by the end of the U.S. steel strike. World prices moved up, but platers here, aware of ready supplies and partially covered with imports, were slow to rush into the market. Business gradually improved, however, with a good demand for spot metal. Prices inched up but ebbed with a decline in plater buying in March.

Business died in the spring, but

Pool support in London enabled N.Y. prices to hold at nearly $1. Platers, it seemed, were happy to have producers and dealers handling the stocks. ITA announced that quotas for the second quarter would be upped 1500 tons to 37,500 in the second quarter. Italy said that it would begin dispersing 2500 tons from its stockpile in September 1960.

ITA retained second quarter quotas for July-September, but withdrew the Buffer Pool manager's authority to buy or sell within a £780-830 (97½-103¾c) range. The manager's activity on the LME had narrowed fluctuation to the point that the Exchange's hedging operation was being hindered. The extreme in price fixing had gone beyond the original intent of the Agreement.

An early summer tightness of supply developed. Indonesian and Congo political unrest kept the market on edge; prices moved up. European dealers, pressed by deliveries to the Pool, became short of metal. A number of factors compounded the situation. Strong European demand provided underlying firmness. Indonesia's sudden switch in smelting operations cut down arrivals; and now when he was needed, the Pool manager wasn't allowed to sell any tin under £830.

Indonesia in its efforts against the Dutch announced that it would in the future smelt all its concentrates in Malaya and Texas City (Wah Chang Corp.). The changeover caught Europe at a bad time, and for a short period dealers there operated without the Indonesian supply. There was no change in shipments to the Texas refinery during the year. N.Y. prices surged in July in line with London's inflation. The latter moved steadily toward £830, the level at which the Pool manager was permitted to sell. It never got beyond £823.

Rumors of U.S. stockpile selling brought the climb to a halt. Unrealistic as they turned out to be, these rumors focused attention on that mound of good metal that the U.S. produced, purchased and took in barter. The U.S. is not a member of the International Tin Council, but can be expected to abide by ITA rules that stipulate public pre-sale announcement of intention to market stockpiled tin. It should be noted that Congress also must act on any release of U.S. stockpiled metal.

The finger of responsibility was pointed at those countries which had failed to fulfill their export commitments. It was undoubtedly at this time that the decision to do away with quotas was reached. With announcement, prices were expected to dip, but the action was reinterpreted and a price slump never came about.

Primary Tin Statistics
(Long Tons)

	1960	1959
World mine output	(c)**160,000**	140,000
World consumption	(c)**180,000**	163,000
World stocks: Gov'ts included	(a)**353,000**	373,000
Gov'ts excluded (d)	(b) **55,000**	75,000
U.S. consumption	**54,000**	46,000
U.S. imports (pig)	**40,000**	43,000
Output Texas City	**10,000**	8,000
Price, av., N. Y. Prompt	**101.438c**	102.053c
Price, av., LME Cash	**£796.634**	£785.21

(a) This estimate was arrived at by adding to the International Tin Study Group figure for the end of 1947 of 135,000 tons, the excess output over consumption each year. (b) I.T.S.G. figure (c) Excludes USSR, includes Red China. (d) Includes Buffer stock (U.K.)

The aggravated market quieted as buying interest in both the U.S. and Europe subsided. Indonesian metal began arriving at Antwerp. An unfettered market was in the offing for the final quarter of the year. But prices stayed up, even with U.S. plater stocks estimated at 50% above normal and very light final quarter activity. Sales scheduled for late in the year were in many cases delayed until early 1961.

Because of good demand and higher prices in Europe, tin was attracted there, keeping the U.S. supply of spot metal at a minimum. Reluctant buyers were made even more so by continued firm prices.

Buying in all markets had slowed as the year entered its final weeks. Prices dropped just below the £780 support level early in 1961. With the Pool manager again purchasing, it is unlikely that prices will get any lower. The Pool held 10,030 tons on June 30, 1960.

Several changes in the new Tin Agreement are noteworthy:

1. Initially the size of the buffer stock will be set at a maximum of 20,000 tons, compared with 25,000 in the original document. Tin metal will be 12,500 tons, with the equivalent value of 7,500 tons in cash.

2. The new draft left ceiling and floor prices open. If ITC does not recommend a change before the old Agreement's expiration on June 30, 1961, the old price limits of £730 and £880 will be continued.

3. The manager will now have the power to borrow money, if need be, to increase the Buffer Stock.

4. No new control period will be declared unless there is likely to be at least 10,000 tons of metal in the Buffer Stock at the beginning of the designated period. The amount is 5,000 tons if controls are recommended after a period in which no quotas were in force. The new Agreement will be for five years. Japan as a consuming member was admitted toward the end of the year. If West Germany joins as rumored, the U.S. will be the only major consuming or producing nation outside the ranks. The U.S. has traditionally avoided market controls.

The Wah Chang Corp. which purchased the U.S.'s only tin smelting facility from the Government three years ago—located at Texas City—shipped both Banka and Wah Chang brands to U.S. markets in 1960. Since Banka tin was also imported from Europe, much of the U.S. output was shipped to the Chicago market. It and the Wah Chang brand were sold at the smelter.

Historically this so-called Grade A brand has sold at a discount of 1¢. Consumers see it matching Straits standards these days and get little more than a ½¢ break on their purchases. Output at Texas City remains secret. Estimates run from 500 to 1000 tpm. Sales to some extent have dented the Malaya Straits tin market here.

Late in the year Bolivia indicated that it would reject a Russian offer of a tin smelter as uneconomical. The U.S. countered with an offer of $10-million for the advancement of tin production facilities. Ore output has been diagnosed as the problem. As the year closed reports from Bolivia were that the Russians might proffer $150-million to doctor up the entire Bolivian economy.

A major technical breakthrough occurred during the year with the introduction by U.S. Steel of ferrolite, a new thinner tinplate which sells for about $3 under the price of standard plate. Its light weight was expected to make it competitive with aluminum which has won favor because of weight advantages in shipping and handling. The tin metal requirement is unchanged.

In looking ahead to 1961, observers are quick to point to the possibility of political disorder. The Congo remains a focal point. Despite fighting and bickering among leaders, tin output, as did that of copper, continued unhampered in 1960. No disruption was expected in early 1961.

Elsewhere . . .

. . . in this issue

In a departure from the regular format of the Annual Survey & Outlook Issue, the editors have included two feature articles of interest to the whole industry.

Electrohydraulics for the breaking and drilling of rock . . . . . p 134

The Education of today's "Average Mining Engineer" . . . . . p 130

It is a certainty that world consumption will have outstripped production by somewhere between 10,000 and 20,000 tons in 1960 when final statistics are revealed. A net shortage of tin was expected to be nearly rectified by the quota-free market that carried over to the new year. Quota removal has yet to drastically increase supply, however.

No indication of a real pickup in buying by platers was in evidence as 1961 began, but improvement in the U.S. economy was widely predicted for the second half of the year.

The year should see greater production in Malaya and Indonesia, improved U.S. consumption and perhaps some leveling off of the European economic spurt. Supply and demand should be more nearly in balance than in the past two years. Consumption may possibly exceed demand by 5000 to 10,000 tons. A continued stable market with prices of $1 to $1.02 per lb is generally forecast.

There will be less talk of U.S. stockpile sales in 1961 now that export quotas have been removed. Also, much of the U.S. Government hoard was taken in at higher prices than currently prevail.

The new ITA will certainly be ratified and go into effect in July. All attempts will be made to maintain a quota-free market in 1961. END

LME Cash Prices

(per Long ton

	Hi	Lo	Av.
1941	283.0	255.1	**261.6**
1942	276.5	276.5	**276.5**
1943	276.5	276.5	**276.5**
1944	301.5	301.5	**301.5**
1945	301.5	310.5	**301.5**
1946	382.0	301.5	**322.7**
1947	513.5	392.0	**427.6**
1948	572.5	513.5	**551.5**
1949	757.0	572.5	**605.8**
1950	1300.0	578.5	**744.6**
1951	1620.0	805.0	**1077.3**
1952	1005.0	917.5	**964.4**
1953	980.0	566.0	**731.7**
1954	825.0	643.0	**719.4**
1955	841.0	679.0	**740.1**
1956	890.0	723.0	**787.7**
1957	804.0	730.0	**754.8**
1958	765.0	640.0	**734.9**
1959	799.0	744.5	**785.4**
1960	818.0	780.5	**796.6**
1960:			
Jan.	795.5	785.7	**791.4**
Feb.	794.5	785.5	**792.4**
Mar.	792.0	782.5	**787.5**
Apl.	798.0	786.5	**790.6**
May	792.0	780.5	**785.1**
June	807.0	782.0	**793.2**
July	823.5	805.5	**812.5**
Aug.	814.0	791.0	**801.6**
Sept.	818.0	799.5	**804.9**
Oct.	813.0	795.0	**804.4**
Nov.	804.0	796.0	**800.6**
Dec.	800.0	786.5	**796.6**

Figures compiled by TIN magazine.

U.S. Lead Use

(Short tons)

	1960 estimated	1959
White lead	**11,000**	11,000
Red lead and litharge	**75,000**	74,000
Storage batteries	**360,000**	380,700
Cable	**60,000**	61,600
Building	**50,000**	53,000
Tetraethyl lead	**165,000**	160,000
Ammunition	**43,000**	45,300
Foil	**4,000**	3,700
Bearing metal	**22,000**	23,300
Solder	**62,000**	69,000
Type metal	**26,000**	28,000
Calking lead	**70,000**	80,000
Other uses	**87,000**	101,400
	1,035,000	1,091,000

Based on U. S. Bureau of Mines statistics.

U.S. Lead Supply and Demand

(Short tons of lead content)

	1960 estimated	1959
Supply:		
Mine production	**240,000**	255,600
Secondary production	**465,000**	447,600
Quota imports		
Ore, recoverable...126,000		
Pigs and bars...222,000	**348,000**	348,000
Other imports (mainly for stockpile):		
Ore, recoverable	—	6,200
Pigs and bars	—	41,400
Total	**1,053,000**	1,098,800
Changes in stocks at primary smelters and refineries	**30,000** (incr.,)	86,600 (decr.,)
Total	**1,023,000**	1,185,400
Exports	**2,000**	2,800
Total available	**1,021,000**	1,182,600
Demand:		
Industrial consumption	**1,035,000**	1,091,100
Estimated stockpile shipments	—	56,000
Consumers and secondary smelter stocks	**20,000** (decr.)	3,600 (incr.)
Unaccounted for	**6,000**	31,900
Total	**1,021,000**	1,182,600

American Bureau of Metal Statistics, U. S. Bureau of Mines, and Lead Industries Association.

Lead Price Changes

(Cents per lb N. Y.)

Dec. 21, 1959	12.00
Dec. 13, 1960	**11.00**

Lead

R. L. Zeigfeld

Despite Continued world overproduction of lead and increasing producer stocks of the metal both here and abroad, the lead market was remarkably steady throughout the year. In fact, the New York price remained at 12c from Dec. 21, 1959 to Dec. 13, 1960, when it was reduced to 11c per lb. Unfortunately, part of this stability undoubtedly resulted from two prolonged strikes in this country, and the price decrease occurred when settlement of the strikes was imminent. However, the fact that consumption held up amazingly well in the face of prevailing general business conditions, declining only 4-or 5%, was probably also a factor.

Pointing toward a brighter future is the tremendous surge of interest shown by a variety of industries in new applications of lead resulting from the intensified advertising, technical service and research provided by the Lead Industries Association and its expanded research program in the last few years. While most of these have not reached the tonnage consumption stage as yet, there is little question that more people are working with more different lead products in more fields of application than ever before, and more technical information is being made available to them with which to work. More will be said about this later.

Consumption. As previously stated, consumption declined only about 5% in the U.S. compared with 1959 and remained above the 1-million ton mark. This was perhaps better than was to be expected in view of general business activity. There were some particularly bright spots in the overall picture. Consumption of lead in tetraethyl lead countered the general trend by showing a modest increase of some 3%. Likewise, production of red lead and litharge increased slightly, reflecting improvement in the consumption of red lead paint and lead chemicals made from litharge. The use of lead for cable sheathing remained practically constant, which may be significant in that the bottom

of the long decline in this use may have been reached.

Storage batteries, the largest users of lead, are expected to show an appreciable decline in lead consumption in 1960. Because of improvements in batteries, they are more efficient and last longer. This has reduced the number of replacement batteries needed, and replacement batteries account for about 80% of the automotive batteries used. Although new car production increased, the trend to compact cars has affected lead consumption because most of the compacts use batteries weighing several pounds less per unit than standard models. The reduction in consumption of lead for solder probably represents lower industrial activity and for calking lead lower construction activity.

U.S. mine production during 1959 reached the lowest level since the turn of the 20th Century and, in 1960, had the dubious distinction of being even lower at an estimated 240,000 tons lead content. Major contributing factors to this were the seven-months-long strikes at the properties of the Bunker Hill Co. and American Smelting & Refining Co. in Idaho. Both were settled in December 1960—the former with the displacement of the Mine, Mill & Smelter Workers as the official bargaining agent after an NLRB election. Primary smelter production was not materially affected and showed a moderate increase because of ores accumulated at the Asarco smelters during a four-month strike toward the end of 1959.

Imports of lead for U.S. consumption were, of course, controlled by quota and remained the same as in 1959. So far as is known there were no imports for stockpile as there were a year earlier.

Production of secondary lead increased moderately in 1960, which indicates that such metal is attracting a greater share of the lead market.

Manufacturers reduced their stocks of pig lead during the year by some 20,000 tons, and, as a result, inventories in their hands are low. However, producers' stocks increased an estimated 30,000 tons.

In the Free World outside the United States, production of lead continued to increase and to run ahead of deliveries, which were well maintained, with a consequent substantial increase in producers' inventories. The natural result was to depress the foreign price, which, despite quotas, had a depressing effect on the U.S. price.

Two meetings of the UN's International Lead & Zinc Study Group were held during the year. At both, insufficient improvement in the world lead statistical picture was found to warrant any change in the voluntary marketing restrictions agreed upon in 1959.

In addition, the report of the reexamination of the lead position by the U.S. Tariff Commission led to no change in the import quotas on lead established by the Administration late in 1958. Efforts by the domestic industry to have these quotas extended to fabricated lead products were fruitless. This permitted foreign manufacturers to continue to take advantage of this loophole by bringing in manufactured products at higher than normal levels outside the quotas. Among the products most affected is litharge, and this undoubtedly results in some understatement of ultimate lead usage in this country in such industries as the ceramic industry, which is importing substantial quantities of lead compounds for use here.

Late in the 1960 session, Congress passed legislation that would have provided subsidies for small domestic producers. This was vetoed by President Eisenhower with the statement that he felt legislation of this type would only aggravate the situation by encouraging additional unneeded production. Statements made by President Kennedy during the campaign, however, indicated that some such legislation may be acceptable to the new administration.

Summary of 1960. Despite the relatively good rate of consumption both here and abroad in 1960, the situation worsened to the extent that the year-end price was lower, producers' stocks were substantially higher and producers' sales of primary lead were substantially lower. In fact, the drop in primary sales was considerably greater than the small drop in consumption. Part of this was due to the lowering of inventories by consumers, but a greater amount of softening and use of secondary material is also indicated. The extremely low level of consumers' stocks of pig lead is encouraging in that any improvement in their business should be promptly reflected in greater purchases from producers. Obviously the only corrective for the situation is less production or more consumption, and not too great a change in either factor would suffice to bring about a balance.

Outlook. With the general business outlook clouded, forecasts for the lead industry are difficult to make. Regardless of general business, however, and barring any drastic recession, it appears that some of lead's major consumers, like storage batteries, tetraethyl lead and cable, should consume as much or a little more lead in 1961 than in 1960. In batteries an increase in replacement of 12-volt batteries in standard size models should compensate for any further trend to compact cars. In 1960 a new, completely redesigned, battery-powered delivery truck came into production and a number were delivered for milk, bakery and similar routes. This may have a major influence on lead consumption for batteries in the years to come. Also, the past year showed a trend toward a higher percentage of battery-powered industrial trucks compared with gasoline- and propane-powered trucks. No doubt the improved efficiency and longer life of lead automotive batteries has largely eliminated the danger of replacement by other kinds of batteries.

Most of the other established uses of lead will depend on the activity of the industries in which it is employed. In this connection two new developments in self-lubricating bearings, one for high temperature duty, involve lead. One is a mixture of lead powder and teflon, and the other a ceramic coating of fused lead oxide. Both are finding commercial applications.

Big break-throughs appear imminent in two important areas. The first is in nose barriers. Late in 1960, the Lead Industries Association issued a research report based on data prepared by the nationally known firm of acoustical consultants, Bolt Beranek & Newman. This report created a deluge of interest in lead as a material for the control of sound. Both in construction and industry generally, control of noise has become a major problem. The report provides basic data which indicates lead to be one of the most efficient and economical noise control materials. Others, working independently, have also incorporated lead in their products for such usage, and a number of articles on the subject appeared in the technical press during the year. High hopes are held for a whole new line of lead applications in this area in the near future.

Piezoelectrics is a term that may not be familiar to everyone but, to put it simply in more words, they are materials that have the ability to convert electric to mechanical energy or vice versa without moving parts. Lead zirconate-titanate is the most efficient piezoelectric thus far found, and it already has important commercial applications. Starting as the tiny stereophonic pick-up element several years ago, it is now the active element in ultrasonic industrial cleaning equip-

ment. This has led to its entry into hotel and restaurant dishwashers. Who knows but what your next home dishwasher or washing machine will depend on the peculiar properties of lead zirconate-titanate. The same material is the heart of a new "spark pump" which replaces the ignition systems of power mowers, outboard motors and the like.

Thermoelectric generators, which convert heat to electricity directly, should also be mentioned. Lead telluride is one of the best and is beginning to find commercial employment in control equipment and other devices.

Other more established uses of lead continue to grow. Our burgeoning nuclear Navy will require more and more lead shielding in the next few years. A number of important new buildings, including the huge Pan Am Building adjacent to Grand Central Terminal in New York; the British Empire's largest office structure, the Ville Marie project in Montreal; a new bank in El Paso, Texas, will rest on lead-asbestos pads. specified to prevent transmission of vibration into the building structures. Airconditioning cooling towers of two new New York skyscrapers rest on similar pads as do the big, high-speed printing presses in the new plant of the Miami Herald. Sixty tons of sheet lead will go into the Pan Am Building foundations alone. END

Magnesium

Dr. J. D. Hanawalt

DESPITE the mild business recession that set in during the second half of 1960, domestic primary metal consumption of magnesium was able to show a slight gain for the year as a whole. Latest estimates of the Bureau of Mines indicate a 1960 total of about 44,000 tons, 7% above 1959's 41,200 tons.

Since projections of third quarter totals indicate that shipments of both wrought and cast products will be somewhat below 1959 figures, the apparent gain in domestic consumption probably was due to increases in chemical and metallurgical uses.

Other pertinent magnesium statistics for 1960 (all, of course, subject to adjustment when final reports are in) were these:

Total shipments of primary and alloy metal were around 54,000 tons, a gain of about 14% from the previous year's 47,532 tons. Exports increased sharply to nearly 15,000 tons. Imports declined from 494 tons to about 250 tons.

Production of primary magnesium increased from 31,033 tons in 1959 to around 39,500 tons in 1960, up 27%. This was considerably less than shipments, so that producers' stocks were reduced by about 10,500 tons, or 25%.

As has been true for some time, slightly over half the consumption of magnesium in 1960 was for chemical and metallurgical end-uses. The trend toward higher average usage of magnesium in aluminum alloys continued in 1960. Consumption for the reduction of titanium, uranium, zirconium, beryllium and other metals showed growth. New applications such as the desulphurization of steel and other usage of magnesium's chemical and thermodynamic characteristics made marked progress and indicate large growth possibilities.

Shipments of magnesium die castings showed a marked rise in 1960, increasing by about 30%. This was mainly the result of an intensive effort to introduce magnesium into automotive applications. Two major parts—a dash panel and an instrument cluster—and a number of smaller parts appear in 1961 model cars. Because of the properties, characteristics and economics of magnesium die castings, the potential for high volume consumption in ensuing model years is excellent. Intensive development work is in progress on melting techniques, metal handling, die casting machines, machining and finishing processes to provide low-cost conversion for mass-produced die castings.

Conventional reverberatory furnaces were used successfully for magnesium melting during World War II, when demand for the metal in bomb casings and aircraft engine parts was considerable. Now, muffled reverberatories, gas-fired radiant heaters and low-frequency induction furnaces are being evaluated in high-tonnage melt operations. The last mentioned type is used by the Volkswagen foundries in Germany to melt 44-million lb of magnesium per year.

High-volume production machining of magnesium on transfer lines (at Volkswagen, for example) is done efficiently and at high speeds without the use of a lubricant. Transfer lines in the U.S. generally are flooded with a water-soluble oil which lubricates and also serves to remove the machined turnings. Both techniques are being investigated for mass magnesium machining in this country.

The development in 1957 of an automatic metering mechanism for supplying molten magnesium to a cold chamber, pressure die-casting machine was a technological breakthrough that put magnesium in its present competitive position. Refinements are being made in this process. In 1960, vacuum die castings of magnesium became a standard, efficient production process in two high-production plants.

At this writing, it appears that magnesium wrought-product shipments in 1960 lagged by 3- to 5% behind 1959. The continued decline in military aircraft procurement was reflected in lesser demand for all wrought forms. Magnesium, particularly the magnesium-thorium alloys for elevated-temperature applications, continues to enjoy favor in missile production, but the missile market has only partially made up for the lost aircraft business.

In commercial end-uses for magnesium wrought products there were some significant increases last year, particularly in luggage, cathodic protection and ground transportation. During 1961, new products and processes will be promoted extensively in an effort to develop new commercial markets. These are:

1. ZE10A sheet and plate, which offer very high joint strength and do not require post-weld stress relief.
2. Special bending sheet, with which critical bends can be made without heated dies, in contrast to conventional magnesium sheet.
3. Precision extrusions, which are delivered from the mill with the equivalent of machined tolerances (as low as ± 0.001 in).
4. Mechanical press forming. Up to now, most magnesium deep drawing has been performed on relatively slow hydraulic presses using graphite lubricants. New test data shows that magnesium sheet can be drawn at high rates on mechanical presses using easily removed soap-type lubricants, thus greatly improving the economics.

Designers also are being made aware of the cost savings inherent in magnesium sheet when used in monocoque (simplified, no rib) designs. Essentially, this prescribes the use of magnesium in a slightly thicker gage than would be used with other metals. The extra thickness provides a panel with sufficient rigidity that most stiffening ribs can be eliminated. Because of magnesium's light weight, there is no weight penalty; there is even a weight saving. But the main

benefit is the cost reduction resulting from savings in fabrication time.

As with wrought products, the cutback in military aircraft production continued to be felt by magnesium sand and permanent mold foundries. Shipments dropped 35% during the first nine months of 1960. No substantial relief in the form of increased missile business is in sight.

By comparison, cast magnesium anodes for the cathodic protection of pipe lines, ballast tanks, etc., were relatively active. Shipments declined only 7%, or about the same as general business. An increase in cast anode business in 1961 is looked for should there be an upturn in the economy as a whole.

The excellent fatigue strength of magnesium is put to good use in the wheels of two airliftable military ground vehicles. The wheels are produced by the permanent-mold process. Aircraft wheels continue to be a main application for magnesium because of the good fatigue serviceability and toughness of the metal, combined with the advantage of its light weight. END

Aluminum

Irving Lipkowitz

THE DECLINE in business generally had its effect on aluminum in 1960 just as it did on other basic materials industries. Instead of the predicted 10-20% increase over 1959 levels, 1960 shipments declined about 6%. Total supply dropped less than 2%, however, because a 3% increase in primary production partially offset the reduced imports and scrap supply.

The excess of supply over shipments in 1960 brought in its wake intensely competitive market conditions. Prices were under heavy pressure in most branches of the industry. Additional competitive pressure also came from other metals and materials. They showed increased resistance to further penetration of their markets by aluminum and greater aggressiveness in trying to invade the aluminum industry's present markets.

The pattern of foreign trade changed substantially during 1960, reflecting both the sluggishness of U.S. markets and the dramatic upturn of European markets. Imports of primary aluminum and scrap continued the decline begun in 1959 while exports doubled in 1960, just as they did in 1959. As a consequence, the U.S. was a net exporter of primary and scrap by a wide margin. While the pattern for semi-fabricated aluminum also revealed a decline in imports and a rise in exports, imports were still twice as large as exports in 1960.

The below-expectation results of 1960 operations have not brought any significant change in the industry's conviction that the prospects for further market development are bright. The decline in 1960 shipments reflected the general business slowdown, not any loss of significant aluminum markets to other materials. On the contrary, aluminum continued to find new markets and uses in 1960 and the industry is confident that it will continue to expand its markets in 1961. The major 1961 challenge confronting the industry is the need to improve prices and profits while the exploration and establishment of new markets continue.

Despite the sluggishness of domestic markets, U.S. primary aluminum markets set a new record in 1960, reaching 2,010,000 tons. Rapidly expanding foreign markets provided important export outlets for a substantial segment of the 1960 production. The 1960 output amounted to a 3% increase over the 1,953,000 tons produced in 1959, which had also been a record year.

The domestic industry had the capacity to produce still more aluminum in 1960, had there been the demand for it. The industry's installed capacity had increased slightly during the year, from 2,402,750 tons to 2,466,250 tons. On the basis of the year's average installed capacity, the industry could have produced about 21%, or 425,00 tons more.

Elsewhere in the world, primary aluminum production also increased over 1959. Other major producing areas registered sharper gains in output than the U.S. did during 1960. In comparing their 1959-1960 percentage increases with the U.S.'s, it should be remembered that they reflect both better production in 1960 and poorer production in 1959 than were experienced in the U.S. Consequently, a better perspective on production trends can be obtained by comparing 1960 growth with both 1957 and 1959. Comparisons are also complicated by substantial differences in the relative development and size of aluminum markets in various parts of the world.

World production of primary aluminum increased from 4.61-million tons in 1959 to an estimated 5.14-million tons in 1960, or 12%. The increase since 1957, when world output was 3.78-million tons, was 36%. As a result, while the U.S. is still by far the largest producer of primary aluminum, its share of world output has dropped from 43.5% in 1957 to 39% in 1960.

Canadian production, after a 6% decline from 1958 to 1959, made a sharp comeback in 1960 with a 29% increase to a new record output of 770,000 tons. The upturn in Canadian operations reflected the much stronger demand which developed during 1960 in many foreign markets, including those of Soviet Bloc nations. As a result, Canada supplied about the same share of world production, 15%, in 1960 as it did in 1957. Canada, however, also had spare capacity during 1960, about a 10% margin over its actual production.

Outside of North America, primary aluminum production was close to capacity levels during 1960. Although the Soviet Union continues to keep its aluminum production statistics secret, the best available guesses are that it is still the second largest producer in the world, with a 1960 output of as much as 900,000 tons, compared with 800,000 tons in 1959. The Soviet Union may have increased its output 15% since 1957.

U.S. Aluminum Supply

(Thousands of tons)

	1960	1959
Primary		
Domestic	**2,010**	1,953
Imports	**150**	240
Scrap (recoverable content)	**440**	449
Total	**2,600**	2,642

Percentage Shares of World Primary Aluminum Production

	1960 %	1959 %	1957 %
U. S.	**39.4**	42.5	43.5
Canada	**15.0**	13.0	15.0
Soviet Bloc	**22.0**	22.5	19.5
Western Europe	**18.5**	19.0	19.0
Japan	**3.0**	2.0	2.0
Others	**2.0**	1.0	1.0
Total	**100.0**	100.0	100.0

U.S. Aluminum Shipments, By Products

(Thousands of tons)

	1960 estimated	1959	Percent change
Sheet and plate	**691**	758	− 9%
Wire, cable, rod, bar	**218**	250	−13%
Extrusions and tubing	**476**	541	−12%
Foil	**122**	126	− 3%
Powder	**15**	17	− 1%
Ingot:			
For castings and destructive uses	**530**	666	−21%
For export	**273**	121	+126%
Total	**2,325**	2,479	− 6%

The sharpest percentage gain in production for the year was achieved by France which increased its output 36%, from 190,000 tons in 1959 to 258,500 tons in 1960. France has been Western Europe's largest producer for some years now. However, its lead over the second largest producer has increased from 7,000 tons in 1957 to 69,900 tons in 1960. In addition, the French companies' production in Africa has risen from 8,000 tons in 1957 to 49,000 tons in 1960, further fortifying France's position as the largest of the West European producers.

Among the other major aluminum producers, Norway apparently nosed out Germany for second place among European producers, with a 1960 production of 188,600 tons as against 160,000 tons in 1959. West Germany increased its output from 167,000 tons in 1959 to 187,200 tons in 1960. Japan was second only to France in its rate of growth as an aluminum producer. Its output rose from 110,000 tons in 1959 to 144,900 tons in 1960, an increase of 32%.

The changing world pattern of aluminum production, indicating the rising importance of areas outside of North America, reflects the increased consumption of aluminum in the industrially developed nations of Europe and Asia.

The record domestic primary production of 1960 did not result in a record supply. The decline in primary imports and scrap supply more than offset the 3% increase in primary production. Total supply for 1960, estimated at 2,600,000 tons, consequently was slightly below 1959, when it amounted to 2,642,000 tons.

The available supply was more than ample to meet all domestic requirements, as indicated by the substantial amounts of primary capacity which were idle during the year and the large exports made during the year. As the following section on shipments shows, they were considerably below supply levels.

Shipments to consuming industries declined about 6% during 1960, compared to 1959. They dropped from 2,479,000 tons in 1959 to 2,325,000 tons in 1960. Actual consumption of aluminum did not experience a similar decline. The 1959 shipments included some inventory-building and thus exceeded actual consumption. In 1960, inventories were reduced and therefore consumption exceeded shipments.

The major decline in shipments occurred in sheet, castings, extrusions, and wire, cable and rod. The shipments of sheet and plate declined from 758,000 tons in 1959 to 691,000 tons in 1960, or 9%. The shipments of the wire, cable and rod group dropped from 250,000 tons to 218,000 tons, or 13%. The extrusion group fell from 541,000 tons to 476,000 tons, or 12%.

The usual ingot classification covering shipments for castings, destructive uses and exports combined showed a 2% rise from 1959 to 1960. However, if this group is subdivided to show ingot exports separately, it reveals that ingot shipments for castings and destructive uses were down 21%, while exports were up 126%.

Aluminum foreign trade set another new record in 1960, the imports and exports of primary, scrap and semi-fabricated aluminum aggregating 576,000 tons, as against 475,900 tons in 1959 which was also a peak year. For the first time since World War II, the U.S. was a net exporter of primary and scrap aluminum. The U.S. continued, however, to be a net importer of semi-fabricated aluminum.

The strong and growing demand for aluminum in foreign markets attracted some of the oversupply which has had difficulty finding a U.S. market. The combined pressure of the domestic producers' efforts to market their output and of the foreign countries' need for aluminum in raw form, created a tremendous surge of primary and scrap exports, from 46,100 tons in 1957 to 153,500 in 1959 and to 353,000 tons in 1960. In three years' time, these exports have thus multiplied over seven times. By the same token, the foreign markets' ability to absorb aluminum supplies and the weakening of U.S. demand brought a drop in primary and scrap imports. They fell from 250,500 tons in 1959 to 160,000 tons in 1960. It is this combination of world market developments which made the U.S. a net exporter for the first time since World War II.

The pattern of semi-fabricated imports and exports also responded to the sharply different business conditions which prevailed in the U.S. and in other industrial countries during 1959. Imports of semi-fabricated aluminum declined for the first time in years, from 55,300 tons in 1959 to 42,000 tons in 1960, because of strong markets elsewhere and unfavorable developments in U.S. markets. Nevertheless, the 1960 imports were the second highest in recent years, almost twice as high as 1957 imports and were exceeded only by 1959 imports. Semi-fabricated exports continued the rise which began in 1959, moving up from 16,600 tons to 21,000 tons. The 1960 exports were still below the 1957 level (21,600 tons) and only half the size of 1960 imports.

During 1960, the domestic aluminum industry continued to expand its foreign operations, both as individual companies and in conjunction with other foreign or domestic companies. The new affiliations extend into all parts of the world, including such widely separated areas as Australia, Greece, Japan and Venezuela. Indicative of the domestic industry's approach to foreign development was the announcement in December of a new Venezuelan project to produce primary aluminum, 80% of which is to be used in Venezuela. Thus, the emphasis in the domestic industry's foreign expansion, as in its foreign

U.S. Aluminum Foreign Trade, 1957-60

(Thousands of tons)

	Unfabricated (Primary and scrap)				Semi-fabricated (Sheet, foil, rod, etc.)			
			Net Balance				Net Balance	
	Imports	Exports	Imports	Exports	Imports	Exports	Imports	Exports
1957....	238.4	46.1	192.3	.....	21.4	21.6	....	0.2
1958....	265.2	71.6	193.6	.....	30.8	15.9	14.9	....
1959....	250.5	153.5	97.0	.....	55.3	16.6	38.7	....
1960....	**160.0**	**353.0**	.....	**193.0**	**42.0**	**21.0**	**21.0**	....

World Primary Aluminum Production

	(Thousands of tons)			Percentage increase	
	1960	1959	1957	1959–60	1957–60
U. S.....	**2,010**	1,953	1,648	3%	22%
Canada.....	**770**	598	557	29%	38%
Soviet bloc....	**1,152**	1,047	740	10%	56%
W. Europe....	**951**	798	712	19%	34%
Japan.....	**145**	110	75	32%	93%
Others.....	**112**	104	48	8%	133%
World total...	**5,140**	4,610	3,780	12%	36%

trade, is on increased foreign consumption of aluminum products.

A combination of developments during 1960 made for intensively competitive aluminum markets. First and foremost was the general business slump which probably hit the metals consuming industries harder than any other segment of the economy. The net result was an oversupply in U.S. markets of all types of aluminum from ingot to the most fabricated forms. Too much supply in search of too little demand had its inevitable effect on prices, selling costs and profits.

Another major influence was the aluminum industry's continued efforts to develop new and larger markets. Aluminum's successful penetration of new markets during recent years has aroused new resistance from other metals and materials. A good example is the vigor with which steel tried to forestall the shift of the orange juice concentrate can market to aluminum. Similarly, in the electrical, construction and automotive markets, inter-in dustry competition has been particularly intensive. With more than enough steel, aluminum and other competitive materials to go around, this competition has required not only resourceful market developmental efforts but also price incentives. As a consequence, many aluminum markets have been subjected, as never before, to the crossfire of two-way competition, both with other aluminum suppliers and with other industries.

In the light of these difficult market conditions, it is significant that the aluminum industry continues to hold its major markets and to develop new ones. Developments in aluminum's two largest markets, construction and transportation, are indicative. In the construction field, new homes now use nearly twice as much aluminum as they did in 1955. The nation's largest manufacturer of pre-fabricated homes, which turned out 200,000 homes during the past 20 years, has been offering aluminum models for only the past three years. In that short period, aluminum has achieved such preference over wood that nine out of ten homes built by this company are now made of aluminum. Wider use of aluminum is also evident in other branches of the construction market, such as office buildings and highway construction.

The transportation market has also been broadened by the expanding use of aluminum in automobiles, railroad cars and ships. The per car consumption of aluminum has increased year after year, as aluminum has been adopted for more components. In the case of the 1961 models, the adoption of aluminum engines by five different cars, and on a limited basis by three additional cars has helped to bring about the sharpest rise in per car consumption of any one year:

Model Year	Average Aluminum Consumption Per Car
1956	35 lb
1957	41
1958	47
1959	51
1960	54
1961	62

The 1961 prospects for aluminum, in terms of tonnages produced, shipped or consumed, depend more than ever before on general business conditions. This fact is the consequence of aluminum's success in becoming a major industrial material. For example, every additional 1961 model car produced means an additional consumption of 62 lb of aluminum. In 1956, every added car meant only 35 lb more of aluminum consumption and in 1948, only 12 lb more. The clue to 1961 aluminum tonnages therefore is to be found largely in the prospects for increased construction, and for a larger output of cars and other durable goods. If the pickup in general business being predicted for the second half of 1961 materializes, 1961 aluminum shipments should show some improvement over 1960.

Tonnages, however, are not the only important element in the industry's 1961 outlook. The 1960 earnings of big, medium and small aluminum companies fell considerably more than their tonnage shipments did. In part, the drop in earnings resulted from price weaknesses because of the oversupply and intense competition among the sellers. But another reason for the lowered earnings was the industry's continued expenditures for the product and market development work which is essential to maintain present markets against the challenges of other metals and materials and to open up entirely new markets. The industry's prospects depend to a considerable extent on how vigorously it will pursue its product and market development activities. Indications to date are that there will be no relaxation of these efforts. Both domestically and internationally, the industry's actions attest to its confidence that bigger aluminum markets can still be built, even in the face of growing competition from other industries and present day general business conditions. END

Zinc

Charles R. Ince

THE YEAR 1960 ended on a disappointing note for the zinc industry. Early optimistic forecasts for the first year of the so-called "soaring sixties" failed to materialize and consumption and prices both here and abroad were at lower levels at the year's finale. Prices on the London Metal Exchange dropped from £94 for Prompt metal in January to £82 in December—a decline of 1½¢ a lb in U.S. currency; and in the U.S. the price declined from a high early in January of 13¢ a lb to a 12¢ level at the end of the year. Naturally, the deterioration in the price situation was due to an oversupply of the metal. Not only was consumption disappointing, particularly in this country, but production continued on an unrestricted basis in the Free World. Only the advent of strikes at the plants of two of the largest U.S. producers saved the markets from a greater weakening.

On the political scene, the outgoing Administration did little to help the domestic mining industry. President Eisenhower vetoed a small mines subsidy bill which had passed both Houses of Congress, and later in the year when the Tariff Commission reported that there had been no improvement in the metal markets, merely continued the import quotas at their current level for another year despite the fact that the quotas had proven inadequate as a means of solving the industry's problems. The United Nations Study Group met twice during the year at Geneva, in February and September. At both meetings there was enough optimism about the state of the zinc market that a continuation of the restrictions on production which had been adopted at the previous year's meeting in New York, were considered unnecessary. In the light of developments since the September meeting, some action toward restraining production might have been in order. While the U.S. had already shown signs of a decline, the rest of the Free World practically without exception was still riding a boom in the use of zinc. Through the first six months every country outside the U.S., with the exception of Canada, registered a gain over 1959, varying from 10% in West Germany to 15% in Japan and India. Canada, due to its proximity to the American economy, reflected the decline in the U.S. and was down about

Table I Consumption by Industries

	1960*	1959	Change from 1959
Galvanizing:			
Pipe, wire etc.	167,000	185,000	−10
Sheet and strip	204,000	176,000	+16
	371,000	361,000	+ 3
Brass and bronze	103,000	129,000	−20
Zinc-base alloys	329,000	390,000	−15
Rolling mills	36,000	43,000	−16
Oxide	15,000	18,000	−17
All others	13,000	15,000	−13
Total	867,000	956,000	− 9

*November and December estimated

Table II Zinc Balance Sheet

	1960*	1961**
Consumption	867,000	902,000
Supply		
Smelter production	868,000	924,000
Metal imports	119,000	140,000
Metal exports	(88,000)	(60,000)
Total	899,000	1,004,000
Surplus	32,000	102,000

*November and December partly estimated.
**estimated.

Total Slab Zinc Smelter Output

(All grades, short tons)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
			Shipments					
			Export & Drawback (Countries)					
1960	Stock beginning	Production	Domestic	OEEC	Other foreign	Gov't. acct.	Total (3, 4, 5, 6)	Stock at end
Jan.	154,419	73,326	79,625	3,190	459	..	83,274	144,471
Feb.	144,471	74,738	78,329	1,149	2,669	..	82,147	137,062
Mar.	137,062	86,028	80,960	2,342	3,222	..	86,524	136,566
April	136,566	83,221	64,551	5,921	1,454	..	71,926	147,861
May	147,861	79,216	54,790	5,005	2,244	..	62,039	165,038
June	165,038	76,723	50,690	1,960	1,425	..	54,075	187,686
July	187,686	73,754	50,002	2,212	2,167	..	54,381	207,059
Aug.	207,059	63,840	64,287	3,753	2,215	..	70,255	200,644
Sept.	200,644	60,004	58,137	2,153	7,892	..	68,182	192,466
Oct.	192,466	63,005	58,572	3,680	2,931	..	65,183	190,288
Nov.	190,288	60,841	56,981	5,394	6,605	..	68,980	182,149
Dec.	182,149	72,933	46,094	7,562	10,616	..	64,272	190,810
Year to date		867,629	743,018	44,321	43,899	..	831,238	
Monthly average		72,302	61,918	3,694	3,658	..	69,270	

Supplementary Report of Production and Stocks

(These figures include all primary and secondary production of standard grades in U. S.)

	Production			Stock at	
	Nov.	Dec.	Year to date	11/30/60	12/31/60
Special High Grade	21,163	30,262	353,585	49,237	61,627
High Grade	4,573	4,247	59,651	13,712	12,268
Intermediate	1,483	1,857	12,294	3,325	4,400
Prime Western (Including Select & Brass Special)	33,622	36,567	442,099	115,875	112,515
Total	60,841	72,933	867,629	182,149	190,810

8%. In this country the first quarter was quite good but with the rapid drop in steel production through the year, except for the abortive rise in September and October with the introduction of the new car models, ended the year with a total consumption nearly 10% below the previous one. During the year, two-thirds of the drop in the Federal Reserve Board's Index of Industrial Activity was caused by a 15-point decline in the index of durable goods materials with which consumption of zinc is closely allied. Over the same period, production equipment showed little or no decline, and consumer non-durable goods dropped only moderately. As can be seen from Table I, not all segments of the consuming industries shared alike in the decline.

Sheet and strip galvanizing registered an increase of 16% over the previous year despite the reduced activity in other parts of the steel industry. Part of this favorable showing was due to the four months' strike in 1959, but much of it can be attributed to the continued growth in the use of continuous-galvanized strip. According to the American Iron & Steel Institute figures, the shipments of galvanized steel represented 4.3% of the total steel shipments as compared to 4.0% the previous year. The Committee of Galvanized Steel Sheet Producers reported that their industry had one of its best years in history in 1960 and is expected to set an all-time record in 1961. Production during the fourth quarter of 1960 should boost the year's total past the 3 million mark and past the 1956 record of 2,958,000 tons. Seven new continuous galvanizing lines will be placed in operation during 1961 and another two or three in 1962 to further increase capacity. Other types of galvanizing were more or less in line with the decline in the steel industry's general activity but nevertheless the improvement in sheet and strip enabled galvanizing to regain its position as the No. 1 customer of the zinc industry, a spot it had lost to die casting the year before.

Zinc usage declined in the die casting industry around 15% despite the best automotive production since 1955 with close to 6.7-million cars being turned out. Unfortunately, around 25% of these were "compacts" which carry substantially less die castings than the full-size cars—in the neighborhood of 25 to 30 lb per unit compared to around 70 lb on the standard models. Most of today's full-size cars use more zinc than ever before and there is every indication that future years will continue this trend. Recent improvements in plating techniques, as well as developments in automotive design, have reinforced and increased the merits of zinc for auto use. Chrome-plated zinc die castings used for such parts as radiator grilles, door handles, rear-view mirrors, headlight and tail-light housings, as well as much exterior trim, can now be relied on for three to five times the service life that has been experienced in the recent past.

In the brass industry, zinc consumption declined slightly more than the drop in that industry's activity owing to the fact that customers of the brass mills returned a larger proportion of brass scrap due to weakening copper markets. This typical reaction is, we hope, over and we should expect a consumption of zinc by this industry this year more in keeping with actual brass production.

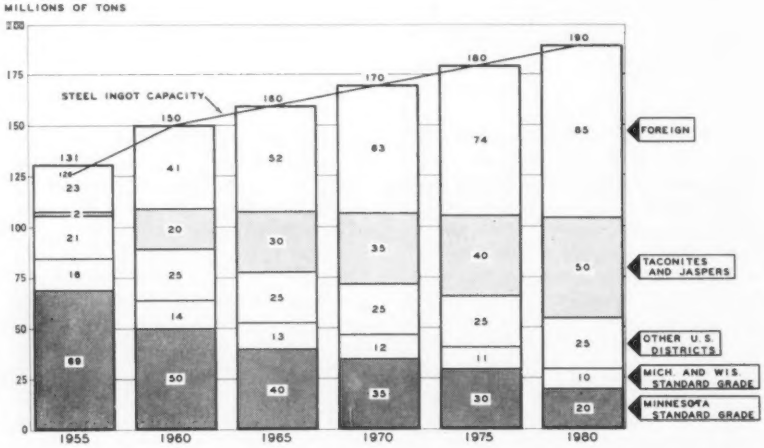
Rolling mills did not fare too well as a user of zinc in 1960 despite the expectations of expanding markets with the launching of the new alloy, Hydro-T metal. It may be too early to judge the merits of this metal.

Total shipments of lead-free zinc oxide to domestic consumers in 1960 are estimated to have been around 170,000 tons, a decrease of about 5% from 1959. The rubber industry, which consumes about 56% of the total zinc oxide, largely accounted for this decline. Total domestic rubber consumption decreased about 5% from 1959 to an estimated 1,560,000 long tons. It is interesting to note that total tire sales increased about 6% over 1959 to an estimated 123-million units, which continues to reflect the increase in use of replacement tires and recaps. The fact that total rubber consumption decreased, is attributed partly to the impact of the compact automobiles, which use about 10% less rubber than the standard size automobile. In addition, the replacement of rubber latex products by polyurethane has undoubtedly been a factor. The paint industry, which consumes about 20% of the total zinc oxide, produced slightly more paint than in 1959, the total gallonage being approximately 660-million. Here again, however, an increasing percentage of this total production is being made in the form of latex emulsion paints, which do not consume zinc oxide. Imports of zinc oxide declined about 25% from the 1959 high of 16,500 tons. Although the Tariff Commission reviewed the zinc oxide import picture early in 1960, no action was taken to close the present loophole in the quota system, which now omits any restriction on manufactured zinc items. It is hoped that legislation covering this whole general field will be enacted during 1961. Our best estimate for zinc oxide consumption in 1961 is that it will be less than in 1960—perhaps as much as 10%.

All other uses of zinc, which include many applications in which statistical breakdowns are not too easily obtained, showed a decline slightly less than the over-all. It does appear that the use of zinc in such items as anodes for cathodic protection and as dust in zinc-rich paints may be growing as compared to the other miscellaneous outlets for the metal.

On the supply side of the picture, as can be seen from Table II, we had more than enough metal to take care of the demand that actually developed. Despite the aforementioned smelter strikes, metal production was about on a par with the previous year. Mine production was still at a very low ebb —only slightly higher than the previous year's rate which, it may be recalled, was the lowest in 25 years, and was more than compensated by complete fulfillment of the zinc ore import quotas, plus the zinc content of fume from Mexico, which was outside of quota. Only the unusually heavy exports of metal and the incompletion of some of the metal quotas saved the domestic market from more grievous problems. As it was, we had a 32,000-ton surplus to cope with in 1960. Looking ahead to this year we are anticipating a slight increase in consumption owing to the fact that manufactured goods inventories have been liquidated and most economic forecasts call for a second half rise in industrial activity. On the other hand, with the labor situation clarified, we may expect a greater output from both mines and smelters unless the price declines further, resulting again in a surplus of about 102,000 tons. Under the circumstances, an improvement in the price level is hard to visualize unless the new Congress and Administration are more protective minded than the previous ones.

For the long pull, however, the prospect for zinc is good. The Expanded Research Program, instituted a few years ago, has opened up new fields of use or expanded the area of older applications. To cite a few—a new series of zinc-base alloys for die castings with improved physical properties and greatly improved fluidity—a new graining procedure and a wipe-on coating for zinc lithographic plates —improvements in welding practices of galvanized steel. With respect to the latter, a wholly new market for zinc has been developed for the use of galvanized steel by the automotive industry which may lead to an increase in zinc consumption of about 100,-000 tons or more annually. About 210,000 tons of continuously galvanized strip will have been used in the 1960 automobiles, mainly on underbody sections, rocker panels (this is the only visible part where hot galvanized strip is used at the present time), as well as traditional uses on exhaust systems, head and tail lamp fittings, etc. When you compare this with 158,280 tons for 1959, 133,215 tons for 1958 and 124,196 tons for 1957, you get a graphic picture of this product's growing importance to car makers. With prospects such as these one cannot be too pessimistic about the long-term outlook for the industry. END



POTENTIAL SOURCES OF IRON ORE for the U.S.[1] Declining shipments of Minnesota standard-grade ores will have to be offset by increasing imports and expanded production of taconite and jasper from vast reserves in Minnesota and Michigan.

Iron Ore and Steel

A. W. Knoerr

NORMALLY, iron ore requirements have been forecast by gaging the requirements for steel. But 1961 is starting with so many unpredictables that formerly bold forecasters are proceeding with caution. During the last half of 1960, manufacturers whittled down their inventories to the bone, thereby beclouding the true steel needs of industry and shunting heavy inventories into the warehouses of steelmakers. This in turn forced a slowdown of steelmaking rates and an accumulation of iron ore and other raw materials at the blast furnaces and shipping points. (See table.) So as iron ore producers face the remainder of 1961, they have sounded the alert

[1] "The Changing Iron Ore Industry," by H. S. Harrison, president of Cleveland-Cliffs Iron Co., E&MJ April 1960, pp 72-73.

that high-cost mines, and those producing sub-premium grades, may face production cuts and shutdowns in some areas. As 1960 closed, Republic Steel Corp. announced that prospects were dim for the re-opening of its Tobin mine near Crystal Falls, Mich. Cleveland Cliffs Iron Co. suspended operations of its Mather "A" mine at the same time, and decreased the work force at the Mather "B" mine in Michigan. Reason given was a low demand for iron ore. Foreign competition, both in steel and iron ores and concentrates, is also changing traditional patterns in the iron ore and steel industry.

Steelmaking furnaces in the U.S. poured 99,277,760 net tons of ingots and steel for castings during 1960, according to the American Iron and Steel Institute. This was the sixth highest annual rate in history. The total exceeded 1959 production by 5.8-million tons, but fell 15% below the 1955 peak of 117-million tons.

McGraw-Hill Department of Economics estimates that 1961 steel output will be about 95-million net tons —an estimate based in part on the department's survey of capital expenditures, recognized as a reliable indicator of economic trends.

Capital Spending in USA

(Billions of dollars)

Year	Total
1959 actual	32.55
1960 estimated	36.06
1961 planned	35.07
1962 planned	33.80

Steel's outlook, and that for iron ore, becomes clearer if we examine the percentages of steel that go to various customers, and then scan the year-end forecasts that have been made for these segments of industry.

Where Steel Goes

Industry	Per cent of total domestic shipments 1959	1958
Automotive industry	**20.9**	17.6
Warehouses and distributors, excluding oil and gas	**16.4**	17.2
Construction, excluding oil and gas	**14.5**	17.5
Machinery, including electrical and farm	**10.5**	10.2
Containers	**9.3**	11.4
Converting and processing	**7.6**	7.8
Oil and gas	**6.9**	6.0
Appliances and other domestic and commercial equipment	**5.4**	5.8
Rail transportation	**3.4**	2.6
Shipbuilding	**1.0**	1.4
All other	**4.1**	2.5
Total	**100.0**	100.0

Now, what is the outlook for these various steel-consuming industries? According to PULSEBEAT, a year-end outlook prepared by the McGraw-Hill Department of Economics in cooperation with more than 600 editors, reporters and economists, here are some predictions:

Automotive industry. Sales of domestic and imported cars are expected to drop from a total of 6.6-million in 1960 to 6-million units in 1961. Taking into account inventories of new and used cars, output of cars will probably be 5.5-million units in 1961, compared with 1960's total of 6.75-million. Truck production in 1961 is forecast at 1.05-million units, a drop of 150,000 from 1960 truck output.

Construction. The 1961 total market for construction materials, labor and contractors' services will surpass $80-billion for the first time in history. Value of new construction put in place will set a record of $58-billion, a 6% increase over 1960. In addition, outlays for maintenance and repairs will continue their steady rise, and add another $22-billion to construction expenditures in 1961.

Machinery and metalworking. Shipments of metalworking industries are expected to top 1960's record volume of $141-billion by another billion dollars in 1961. Trends for individual metal goods industries are as follows: Metalworking machinery manufacturers foresee a 6% rise in shipments this year. Shipments of machine tools, both cutting and forming, are expected to exceed the 1960 total of $650-million by 8% in 1961. Shipments of construction and mining machinery should rise by about 3% during 1961, but heavy inventories will slow down production slightly. Manufacturers of other industrial machinery such as pumps, turbines, engines and compressors anticipate a 5% lower volume of business in 1961.

Electrical apparatus. Makers of transmission, generating and distribution equipment expect a 4% gain in physical volume of shipments in 1961.

Farm machinery. Manufacturers expect 1961 sales to perk up about 4%. Ford Motor Co. Tractor Division estimates that farm equipment sales will be up by 15% in 1961.

Containers. Of the 6.3-million tons of steel shipped for containers in 1959, 5-million tons went into cans and closures—chiefly used in the food and beverage industry. Over-all food and beverage production ran 3% higher in 1960 than in 1959, and the 1961 figure is expected to climb an additional 3%.

Iron Ore Use and Consumption In the U.S. for the First Eleven Months of 1960 and 1959

(Millions of gross tons)

	1960	1959
Receipts at iron and steel mills (11 months)		
From Lake Superior district	**67.04**	40.07
From other U. S. sources	**14.03**	12.33
From Canadian sources	**13.12**	14.50
From other foreign sources	**22.76**	14.60
Total	**116.95**	86.50
Consumption in the U. S. (11 months)		
Ore from Lake Superior district	**53.02**	50.14
Ore from other U. S. sources	**14.22**	12.30
Ore from Canadian sources	**14.16**	11.40
Ore from other foreign sources	**20.97**	14.99
Total	**102.37**	88.83
Inventories in iron and steel plants (at end of Nov. 1960)		
Ore from Lake Superior district	**45.68**	31.85
Ore from other U. S. sources	**3.48**	3.29
Ore from Canadian sources	**8.31**	10.14
Ore from other foreign sources	**16.53**	15.20
Total	**74.00**	60.48

Source: American Iron Ore Association, Cleveland 15, Ohio. Figures above include iron ore agglomerates.

Oil and gas. Capital spending for the three steel-consuming phases of the oil and gas industry—production, transportation and refining—for 1961 should total about $5.18-billion, up slightly from 1960's $5.0-billion total.

Consumer durable goods. In this area, which includes items all the way from cars to refrigerators, a buying slowdown set in in mid-1960 which is expected to persist through the first half of 1961. Reasons cited are: A mounting burden of consumer installment debt, a slowdown in income gains, and a decline in consumer confidence in the business outlook.

Changing patterns in the steel industry have forced several distinct changes in the iron ore industry. Two factors, competition and modernized technology, are chiefly responsible for the changes.

Competition. In January 1961 INVESTORNEWS, Benjamin Fairless,

president of the American Iron and Steel Institute said "for quite some time, in the steel business, we used to consider that 10% of our production was for export. Now there has been a reversal." The export reversal between the years 1954-55 and the years 1959-60 represents a 10-million ingot ton loss for the American steel industry, or 10% of the 1960 volume. Fairless said that foreign prices were a staggering $20 to $40 per ton below domestic steel prices. To meet this kind of unprecedented competition, steelmakers say that they will need: (1) Continued high capital investments in modern steel-making equipment, (2) The understanding cooperation of labor in maintaining high productivity rates, (3) Lower freight rates in the U.S., particularly by rail, (4) more liberal depreciation allowances from the Federal Government to offset inflationary costs, (5) lower state mining taxes, and (6) high-grade economic feed for the blast furnace.

Increasing imports of ores and agglomerates will be necessary to sustain the high steel producing rate of the U.S., as indicated in the accompanying chart.[1] Imports of iron ore have risen steadily from 5-million tons in 1947 to approximately 36-million tons in 1959 and 1960. But despite this rise, and the competition now existing between domestic and foreign ores, the steel industry and the majority of iron ore producers are opposed to tariffs or other forms of protection. At the 1960 American Mining Congress meeting, C. F. Beukema, president of Oliver Iron Mining Division, U.S. Steel Corp. said "Our nation must take care that it does not do great harm to the basic steel industry by misguided efforts to 'protect' the domestic iron ore industry, and by so doing, augment iron and steel production costs, and thus jeopardize further the competitive position of our iron and steel industry both at home and abroad and weaken our nation."

Changing technology. Iron ore producers observe that certain ores which have qualified as commercial shipping ores in the past are no longer marketable. This is a direct result of steelmakers' progress in force-feeding blast furnaces with a richer diet of iron units in the form of upgraded iron ore or pelletized concentrates. As the result of technological progress, the annual average capacity of a blast furnace in the U.S. has been increased from 240,000 tons of pig iron in 1940 to 367,000 tons in 1960. Feeding high-grade ores and agglomerates to the blast furnace also cuts down the requirements for other raw materials as well as iron ore. During the 1947 to 1959 period requirements of raw materials to make a ton of steel were reduced as follows: iron ore, from 2.554 lb to 2.263 lb; limestone, from 717 lb to 459 lb; and coal, from 1.915 lb to 1.477 lb. Scrap requirements have remained fairly constant at about 1.075 lb. In the nickel-shaving competitive world market which the domestic steel industry is now bucking, it's obvious that steelmakers will have to press for increasingly high-grade ores, concentrates and agglomerates from iron ore producers.

Direct reduction of iron ore, which promises to by-pass blast-furnace steelmaking under certain economic conditions, continued to be one of the liviliest of technical subjects during 1960. A comprehensive summary of most recent developments in this field appears in "Iron—How Is Direct Reduction Doing Commercially," by Colin McAneny, E&MJ, December 1960.

A survey of the new mines and plants in the mining industry indicates that capital expenditures for current and future projects in the domestic and foreign field will exceed those for any other metal or mineral commodity. (See E&MJ, January 1961, pp 80-87.) Among the projects included in the survey are: Iron Ore Co. of Canada's 7-million-tpy Carol Lake project in Labrador; Quebec-Cartier's 8-million tpy project in Quebec; U. S. Steel's $50-million mining and beneficiation project at Atlantic City, Wyo.; Wabush Iron Co., Ltd.'s $200-million, 4- to 5-million tpy project in Labrador; the Pea Ridge, Missouri, $40-million underground mining project of Bethlehem Steel Co. and St. Joseph Lead Co.; Reserve Mining Co.'s $120-million expansion program, which will increase pellet production to 9-million tpy in Minnesota; Webb & Knapp Strategic Corp.'s proposed $34- to $40-million direct-reduction plant to make steel from Anaconda's 40-million-ton copper slag pile in Montana; and Kaiser Steel Corp.'s newly completed $22.7-million beneficiation and blending plant at Eagle Mt., California. END

Silver

Francis H. Wemple

PRICES were steady and demand was strong in world markets throughout 1960. Increasing economic activity abroad was in contrast to some slackening in the U.S., and world consumption for industrial uses was about 5% ahead of the previous year.

Total U.S. consumption of silver by industrial users amounted to about 100-million oz in 1960, about 3% below 1959. Consumption in sterling holloware and flatware held up well, and photographic uses increased. On the other hand, demand for silver in the metal joining, electrical and electronic fields was down, due largely to the effect on the metal business of reduced production in consumer durable goods; including air-conditioning, refrigeration, and electrical appliances. However, the number of applications for silver, for military as well as civilian purposes, continued to grow, and helped to offset the drop in some of the more established uses.

There was no price change in the New York silver market during 1960. The availability of Treasury silver to domestic users at a delivered cost of 91⅝¢ per troy oz established the maximum price to consumers. On this basis the New York published price, which is the price paid for silver in unrefined materials, was issued at 91⅜¢, the usual ¼¢ below the price for refined bar silver offered for nearby delivery at New York.

The sale of Treasury silver to industry has been an important factor in the silver market for the past two years. The Act of July 31, 1946 authorizes the Treasury to sell non-monetized silver, commonly called free

Silver Quotations

	New York Price			London Spot		
	High	Low	Average	High	Low	Average
1960	**91.375¢**	**91.375¢**	**91.375**	**80.250d**	**79.000d**	**79.378d**
1959	91.625	89.875	91.202	80.250	75.875	78.818
1958	90.375	88.625	89.044	78.750	74.750	76.211
1957	91.375	89.625	90.820	80.500	77.125	78.927
1956	91.625	90.000	90.826	81.375	76.625	79.132
1955	92.000	85.250	89.099	80.250	73.750	77.507
1954	85.250	85.250	85.250	74.375	72.000	73.482
1953	85.250	83.250	85.188	74.000	72.875	73.945
1952	88.000	82.750	84.941	77.000	72.500	74.360
1951	90.160	80.000	89.368	78.500	70.000	77.856

Treasury Silver

(Millions of oz)

	Dec. 31 1960	Dec. 31 1959	Dec. 31 1958	Dec. 31 1957	Dec. 31 1956
Held in Treasury:					
Securing Silver Certificates:					
Silver bullion	1,741.8	1,741.3	1,736.3	1,711.5	1,708.4
Silver dollars	124.9	141.1	156.8	169.4	182.8
Subsidiary coin	2.0	2.4	10.9	5.9	2.0
Free Silver bullion	123.5	175.1	202.2	127.4	87.4
Total treasury stocks	1,992.2	2,059.9	2,106.2	2,014.2	1,980.6
Outside the Treasury:					
Silver dollars	252.3	236.3	220.8	208.3	195.1
Subsidiary coin	1,139.9	1,094.7	1,046.2	1,014.6	968.0
Total Silver Outside the Treasury	1,392.2	1,331.0	1,267.0	1,222.9	1,163.1
Total silver	3,384.4	3,390.9	3,373.2	3,237.1	3,143.7

World Silver Consumption — (Partial)

(Millions of oz)

Industrial Uses;	1960	1959	1958	1957	1956
United States	100.0	103.0	85.0	95.0	100.0
Canada	4.2	4.4	4.6	5.8	3.8
Mexico	4.0	5.4	4.4	3.9	3.9
United Kingdom	16.5	17.5	14.8	14.7	13.8
France	13.0	10.6	14.1	17.9	15.9
Western Germany	40.2	33.3	31.1	31.5	33.1
India	1.5	2.0	3.3	15.0	17.5
Japan	21.6	13.6	8.2	8.8	7.9
Other countries (partial)	25.0	25.0	25.0	20.0	20.0
Total (partial)	226.0	214.8	190.5	212.6	215.9
Coinage;					
United States	46.0	40.6	38.2	52.0	31.2
Canada	7.5	5.7	4.7	3.8	3.2
Mexico	2.6	1.4	2.2	3.1	4.9
France	12.2	6.4	—	—	—
Other countries (partial)	25.0	30.0	34.4	25.1	17.3
Total coinage (partial)	93.3	84.2	79.5	84.0	56.6
Total consumption (partial)	319.3	299.0	270.0	296.6	272.5

World Silver Production (Partial)

(Millions of oz)

	1960	1959	1958	1957	1956
Mexico	44.0	44.1	47.6	47.1	43.1
United States	39.0	23.0	36.8	38.7	38.7
Canada	32.5	31.9	31.2	28.8	28.4
Peru	25.0	24.8	25.9	24.8	23.0
Bolivia	5.0	4.5	6.1	5.4	7.5
Other South and Central American countries	7.0	6.9	7.2	6.9	7.1
Total Western Hemisphere	152.5	135.2	154.8	151.7	147.8
Outside the Western Hemisphere (partial)	50.0	48.8	50.9	46.3	45.2
World Production (partial)	202.5	184.0	205.7	198.0	193.0

U.S. Silver Imports

(Millions of oz)

	1960	1959	1958	1957	1956
Imported from;					
Canada	21.4	23.5	19.6	18.0	20.0
Mexico	10.3	16.8	20.6	16.5	18.9
Peru	12.2	10.8	15.6	13.1	11.4
Bolivia	2.7	2.4	3.4	3.5	5.5
Other Western Hemisphere Countries	4.0	6.0	6.5	5.1	4.5
Total Western Hemisphere	50.6	59.5	65.7	56.2	60.3
United Kingdom	—	0.5	.4	22.3	67.7
Netherlands	—	—	4.3	4.7	19.3
Other European Countries	0.1	0.3	0.1	0.1	—
India	—	—	82.0	89.5	—
Pakistan	4.6	4.6	5.7	30.3	—
Australia	1.3	1.4	1.5	1.7	11.5
All Other Countries	3.7	2.8	6.2	1.3	4.0
Total Imports	60.3	69.1	165.9	206.1	162.8

U.S. Silver Exports

(Millions of oz)

	1960	1959	1958	1957	1956
Exported to;					
Canada	1.8	1.0	—	1.4	1.0
United Kingdom	4.9	2.7	0.1	3.8	1.6
France	8.2	1.2	—	0.1	—
Western Germany	6.4	3.1	1.0	2.8	0.3
Japan	4.7	1.1	—	—	—
All other countries	0.7	0.1	1.6	2.2	2.6
Total exports	26.7	9.2	2.7	10.3	5.5

silver, to domestic industry at not less than 90½¢ per troy oz. A schedule of selling prices has been established as follows: 91¢ per fine troy oz delivered at the San Francisco Mint; 91½¢ delivered at the Denver Mint; and 92½¢ delivered at the New York Assay Office. These differentials represent the cost of transportation by Railway Express to the East from Denver and San Francisco. However, silver may be transported by common carrier truck from the West Coast at ⅝¢ per troy oz, and accordingly the most economical source of Treasury silver is the San Francisco Mint.

The use of free silver is limited, and one limitation is that it may not be exported. This means that foreign buyers do not enjoy the same privilege as domestic buyers, and must rely on private sources. As a result the New York market has become isolated to some extent from the other markets of the world, and the published price in New York has been fractionally lower than prices quoted elsewhere. Suppliers have continued to sell substantial quantities in the U.S., but users here have had recourse periodically to the Treasury for a portion of their needs.

U.S. imports of silver in refined and unrefined form during 1960 amounted to about 60.3-million oz. Excluding returns against lend-lease of 4.6-million oz, the balance of 55.7-million oz was about 13% below the comparable figure for 1959. Total U.S. exports in 1960 amounted to about 26.7-million oz, which was nearly three times the 1959 volume. In addition to the inducement of higher prices abroad, which existed to some extent also during 1959, the increase in exports was the result of larger supplies being available. In 1959 protracted strikes at the principal refineries restricted deliveries of bar silver.

Further progress was made during 1960 toward cleaning up the outstanding balances on the lend-lease accounts. As previously agreed, Pakistan returned 4.6-million oz during the year, and the remaining balance of 9.2-million oz is to be returned in

two more equal annual installments. Negotiations are in progress for the settlement of the Saudi Arabian obligation amounting to 21.3-million oz.

Treasury free silver has received considerable attention in recent years in view of its importance as a source of supply for domestic industry. On December 31, 1960 free silver stocks amounted to 123.5-million oz, down from 175.1-million oz on the same date a year ago, a drop of more than 50-million oz, or approximately 30%.

During 1960 Treasury free silver stocks were reduced by withdrawals for coinage requirements of about 46-million oz, and by sales to domestic industry under the Act of July 31, 1946 of about 21.5-million oz. Partly offsetting withdrawals were additions to the stocks of approximately 16-million oz resulting almost entirely from the verification and crediting of previously returned lend-lease silver. As of Dec. 31, 1960 about 13.2-million oz of lend-lease silver were on hand but not yet verified. Adding the 30.5-million oz still outstanding, there is an indicated potential addition to free stocks in the future of approximately 43.7-million oz.

Consumption of silver outside the U.S. maintained a high level and in some countries increased sharply during 1960. Throughout most of the year, the pressure of world demand resulted in higher prices abroad than those published in New York. The year's closing quotation in London, for example, was 79⅜d, which was equivalent to 92.73¢ per troy oz.

Consumption of silver throughout the non-Communist world during 1960 amounted to a total of 319.3-million oz, an increase of about 7% over 1959. Industrial uses were up 5% and amounted to 226-million oz. Consumption for coinage was up 11% and amounted to 93.3-million oz. In both categories nearly half was accounted for by the United States.

Total silver production for non-Communist countries amounted to about 202.5-million oz, an increase of about 10% from the previous year. Production during 1959, however, was affected by prolonged strikes in the U.S., and the curtailed output in that year was to some extent recovered in 1960.

Total world consumption during 1960 exceeded new production by some 116.8-million oz. New production, however, is only one source of silver. In addition, demonetized coinage provided about 10-million oz, and about 67.5-million oz came from free silver stocks of the U.S. Treasury (of which 46-million oz were accounted for by United States coinage requirements). Official stocks of other countries provided about 12-million oz; sales from Red China accounted for 9.7-million oz; and the difference was made up in the total from miscellaneous sources.

The coming "shortage" of silver is attracting interest, and there have been predictions of an early and substantial price increase. These discussions have usually referred to the well known fact that consumption has regularly exceeded new production for some time, and have pointed out that Treasury free stocks have declined substantially over the past two years.

The statistics by themselves tend to exaggerate the situation. Historically there have always been secondary sources of silver becoming available to the market at different price levels. The sale by Cuba a few years ago of its demonetized coin was an example. At present Treasury silver is such a source. There may well be others in the future. Furthermore, Treasury free silver stocks are still large in spite of substantial reductions, and there is no present indication that the incoming administration is planning any change in the Treasury's silver policies. So long as these policies remain unchanged, the short-term outlook is for continued price stability in the United States.

Turning to the longer range outlook, however, higher price levels for silver eventually can be expected. Free silver is a limited source of supply. It seems quite certain that world economic conditions will continue to expand during the 1960's, and that demand for silver will tend to increase without compensating increases in new production. Additional sources of secondary silver presumably will appear only at more attractive prices, and the natural forces of supply and demand will inevitably exert their influence on the market. END

Uranium

Robert W. Bernick

THE "STRETCH-OUT" of uranium concentrate procurement by the U.S. Atomic Energy Commission had world wide repercussions during 1960.

It was major news within domestic segments of the raw materials industry, where AEC had pushed implementation of the program.

In Canada, which sells the bulk of its concentrates to the U.S., a stretch-out of contracting ending in 1962 and 1963 resulted in a number of mergers of uranium firms, consolidations of contracts and some economic dislocation. The objective here was achievement of greater efficiency and economics in view of the changes in pace of U.S. and United Kingdom procurement.

Within the U.S., the pattern of most major mill negotiations was to obtain lower prices for concentrates delivered to the end of the Circular Five Program (March 31, 1962) to compensate for the straight $8 a lb price which will prevail on U_3O_8 delivered between March 31, 1962 and Dec. 31, 1966. (Actually, some deliveries will be made after Dec. 31, 1966 but only in terms of the "fiscal" 1966 period.)

The central document projecting the procurement of uranium materials from U.S., Canadian and overseas sources was "promulgated" in April 1959 by Jesse Johnson, director of raw materials procurement, at Wyoming Mining Assn. meeting, Riverton, Wyo.

Here Mr. Johnson estimated total procurement to fiscal 1966 (including first half 1967, of course of 163,570 tons of U_3O_8. Of this amount, 115,100 tons would come from domestic sources; 26,900 from Canadian and 21,570 tons from foreign.

On basis of present contracting, E&MJ figures that total procurement by the AEC in this period will now be around 160,100 tons of concentrates.

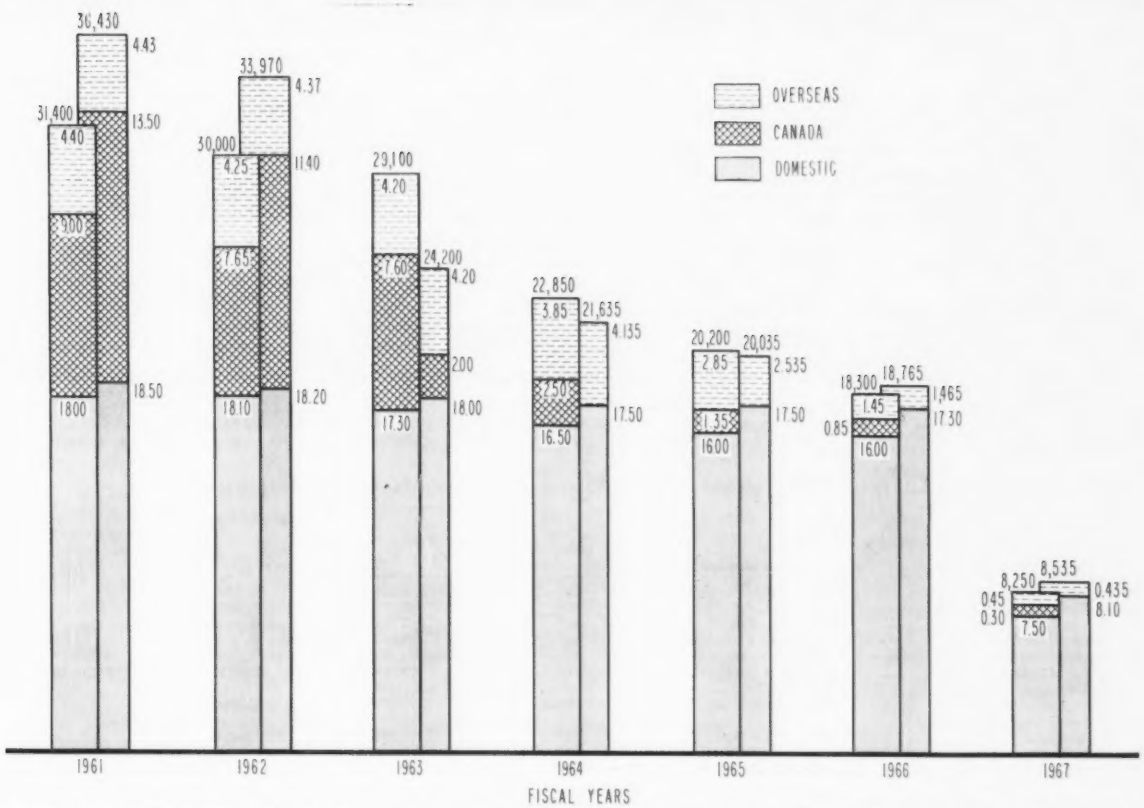
The U.S. estimate has been reduced to 109,400 tons while the Canadian commitment was increased to 29,250 tons. Overseas contracting was reduced slightly to 21,450 tons.

AEC already had explained that the 3,650-ton increase in the Canadian commitment resulted from verbal commitments later executed into contracts prior to the announcement that the U.S. would not exercise an option to acquire more Canadian concentrates beyond contracts expiring in 1962 and 1963.

The accompanying chart shows the changes which the stretch-out has meant in deliveries of Canadian concentrates to the U.S. It also discloses that changes have been made in shipments from overseas sources—principally South Africa and Australia.

The change in procurement of domestic concentrates is believed largely to reflect situations in certain areas of the west where independent ores did not add up to earlier estimates.

As a consequence, AEC already has indicated that some of the 27 operating mills in the U.S. probably



HOW AEC ESTIMATES CHANGED in the 1960 revision from April 17, 1959 commitments. Bars in the foreground indicate the 1960 figures (in thousands of short tons). Background bars indicate the 1959 commitments, with totals at the top shown in tons, not thousands. Range is from 1961 to end of fiscal 1967, showing a total reduction of 3,470 tons.

will not carry operations past present contracts. And some of the "extended" contracts do not run all the way to Dec. 31, 1966 date.

The Hon. Robert Winters, Canadian uranium leader, said the Nov. 6, 1959 announcement that the U.S. AEC would not exercize its options had a "severe" effect on Canada's miners—and in fact—the entire Canadian economy.

"An illustration of what I mean is Northspan Uranium Mines Ltd., which consisted of three mining properties built and developed at a cost of $100-million. They reached full production only in 1959. Two of the mines are already closed and by the middle of 1961, all three properties will be on a care and maintenance basis with their facilities contributing nothing to the Canadian economy.

"The economic consequences of the Nov. 6, 1959 decision on a national basis were also considerable. In 1959, the uranium industry earned $320-million in foreign exchange . . . amounting to over 6% of total Canadian export earnings. . . .

"A number of amalgamations of companies have taken place . . . and the whole industry is, in fact, shaking down to a hard core. . . .

"Extensions of operating life, through the acquisition of outside contracts, have been achieved by Eldorado and Gunnar mines in the Beaverlodge Area and by the Rio Tinto and Denison mines in the Elliott Lake area. The net result in the over-all Canadian picture . . . is that the Port Radium mine has ceased to operate; two mines and mills remain operating in the Beaverlodge area; seven of the 11 original integrated mining and milling operations are still running in the Elliott Lake area, with two more to close in the near future; two mines and mills in the Bancroft area will run at least until the normal expiry of their contracts," Mr. Winters said.

On the basis of present contracts, he added, "there is only enough poundage left to ensure that at the beginning of 1966 there will be only one uranium mine and mill left operating in Canada. The others will be closed in the intervening period unless there are additional orders."

In Australia, the Rum Jungle plant produced 326,506 lb of U_3O_8 in 1960, compared to 335,840 lb in 1959. The plant obtains concentrate from uranium ore and from uranium-copper ores produced at the Mary Kathleen, United Uranium and South Alligator Uranium mines.

Loren K. Olson, a member of the U.S. AEC, reports that at the beginning of fiscal 1961, approximately 50,700 tons of U_3O_8 remained to be delivered to the Commission from all foreign sources. He estimates that 29,300 tons will come from Canada and 21,400 tons from overseas sources.

Mr. Olson said that as a result of the AEC decision not to purchase any concentrates in the 1966 procurement program from ores discovered after Nov. 24, 1958, the U.S. will have between 45- and 50-million tons of 0.25% U_3O_8 ore (average grade) available six years from now. This is nearly a 10 year supply at present rate of milling.

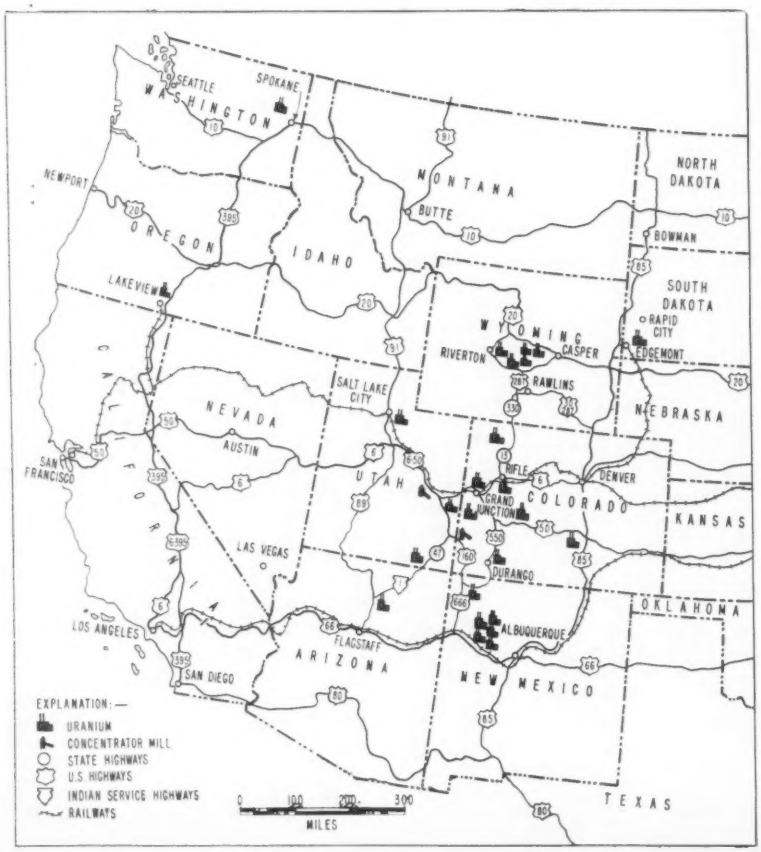
U.S. reserves were estimated at 86-million tons at start of 1960 containing 240,000 tons of concentrates. About 18,000 tons of concentrate was purchased from domestic sources in the current fiscal year and Mr. Olson projects procurement at that level for the 1962 fiscal period.

Negotiated AEC Uranium Purchase Commitments 1960-1966

Company	Mill location	Capacity (tpd)	Total contract ($ million)	Expiration	Specific Commitments: Until 1962 (millions of lb U308)	Specific Commitments: 1962 to expiration (millions of lb U308)
Anaconda Co.	Grants, N. M.	3000	$132	12/31/66	7/1/60–4/1/62; 5.25 @ $8.79/lb	10.709 @ $8/lb
Climax Uranium Co.	Grand Junction, Colo.	330	$21	12/31/66	8/1/60–4/1/62; 1.037 @ $8/lb	1.561 @ $8/lb
Cotter Corp.	Cannon City, Colo.	200	$20	2/28/65	7/1/60–4/1/62; .898 @ $8.62/lb	1.503 @ $8/lb
Dawn Mining Corp. (Newmont Mining)	Ford, Wash.	400	$30	12/31/66	7/1/60–4/1/62; .999 @ $9.27/lb	2.610 @ $8/lb
Federal-Radorock-Gas Hills Partners	Fremont Co., Wyo.	520	$41	12/31/66	7/1/60–4/1/62; 1.363 @ $8.15/lb	3.700 @ $8/lb
Globe Mining Co. (Union Carbide)	Natrona Co., Wyo.	490	$34	12/31/66	7/1/60–4/1/62; 1.139 @ $8.30/lb	3.091 @ $8/lb
Susquehanna-Western Inc. (Susquehanna Corp.)	Riverton, Wyo.	500	$47	12/31/66	6/1/60–4/1/62; 1.503 @ $8.63/lb	4.272 @ $8/lb
Kermac Nuclear Fuels Corp.	Grants, N. M.	3300	$237	12/31/66	to 6/1/63: 13.877 @ $7.18/lb	17.150 @ $8/lb
Western Nuclear Co.	Jeffrey City, Wyo.	845	$90	12/31/66	to 4/1/62; 2.829 @ $7.72/lb	8.527 @ $8/lb
Gunnison Mining Co.	Gunnison, Colo.	200	$9.2	12/31/62	7/1/60–7/1/62; .823 @ $9.19/lb	.206 @ $8/lb
Homestake-Sapin Partners	Grants, N. M.	1500	$118	12/31/66	7/1/60–4/1/62; 4.021 @ $8/lb	10.680 @ $8/lb
Kerr-McGee Oil Industries, Inc.	Shiprock, N. M.	300	$14.5	6/30/65	7/1/60–4/1/62; .942 @ $8/lb	.873 @ $8/lb
Petrotomics Co.	Shirley Basin, Wyo.	500	$25	12/31/66	to 3/31/62; 1.024 (eligible ores) (undisclosed price)	3.158 @ $8/lb
Phillips Petroleum Co.	Grants, N. M.	1725	$152	12/31/66	7/1/60–4/1/62; 5.862 @ $7.75/lb	13.346 @ $7.96/lb
Susquehanna Western, Inc. (Susquehanna Corp.)	Falls City, Texas	200	$13.3	12/31/66	7/25/60–4/1/62; .338 @ $9.90/lb	1.247 @ $8/lb
Uranium Reduction Co.	Moab, Utah	1500	$169	12/31/66	7/1/60–4/1/62; 6.176 @ $8.15/lb	14.773 @ $8/lb
Utah Construction & Mining Co.	Fremont County, Wyo.	980	$91	12/31/66	7/1/60–4/1/62; 2.961 @ $7.80/lb	8.433 @ $8/lb

Current AEC Uranium Purchase Commitments Under Review

Company	Mill location	Capacity (tpd)	Total contract ($ million)	Expiration	Specific Commitments: Until 1962 (millions of lb U308)	Specific Commitments: 1962 to expiration (millions of lb U308)
Union Carbide Nuclear Corp.	Rifle, Colo.	1000	$56	3/31/62	7/1/60–4/1/62; 5.773 @ $9.65/lb	
Union Carbide Nuclear Corp.	Uraran, Colo.	1000	$24	3/31/62	7/1/60–4/1/62; 2.491 @ $9.65/lb	
Vanadium Corp. of America	Durango, Colo.	750	$14	3/31/62	7/1/60–4/1/62; 1.750 @ $8.02/lb	
Vitro Chemical Co.	Salt Lake City, Utah	600	$13.6	3/31/62	7/1/60–4/1/62; 1.403 @ $9.69/lb	
Homestake-New Mexico & Partners	Grants, N. M.	750	$29	3/31/62	7/1/60–3/31/62; 3.460 @ $8.31/lb	
Lakeview Mining Co.	Lakeview, Ore.	210	$13.6	11/30/63	7/1/60–4/1/62; .805 @ $9.27/lb	.767 @ $8/lb
Mines Development Corp. (Susquehanna Corp.)	Edgemont, S. D.	400	$9.3	3/31/62	7/1/60–3/31/62; .939 @ $9.87/lb	
Rare Metals Corp. of America (El Paso Nat. Gas Co.)	Tuba City, Ariz.	300	$11.7	3/31/62	7/1/60–3/31/62; 1.096 @ $10.70/lb	
Trace Elements Corp. (Union Carbide)	Maybell, Colo.	300	$11.7	3/31/62	7/1/60–3/31/62; 1.255 @ $9.29/lb	
Texas-Zinc Minerals Corp.	Mexican Hat, Utah	1000	$95 (under review)	12/31/66	7/1/60–4/1/62; 3.098 @ $8.95/lb	8.408 @ $8/lb



U.S. URANIUM MILLS are now completing negotiation with AEC for the output of U_3O_8 between 1962-1966.

U.S. reserves as of Jan. 1, 1961 are estimated by E&MJ to be around 80-million tons, assuming no new major discoveries had been made during 1960—and none were reported.

However, some Gas Hills and Shirley Basin district operators in Wyoming were reported to be continuing to drill ore extensions for purposes of estimating their reserves after the 1966 term.

And down in the Monument Valley of northern Arizona, Texas Zinc Minerals Corp. was drilling merrily away, hunting for new ore reserves. The firm, which hadn't reported much success at year's end, holds one of the "old type" contracts with AEC which provides only for poundage delivery. This contract runs to Dec. 31, 1966 and can be re-opened only if both parties consent.

AEC continued to wrestle with the allocation of ore reserves on basis of the Nov. 24, 1958 curtailment. It had received during 1959 and 1960 some 2650 statements as to reserves from operators owning thousands of mining claims. Most of the ore reserve allocation was completed by end of

1960. But a good deal of work remains; for the miners were contesting heatedly AEC's findings in some districts.

AEC now has finished negotiation of 17 of the 27 mill contracts and announced commitment to purchase $1.5-billion worth of uranium concentrates between July 1, 1960 and end of 1966 concentrates procurement program.

Late in December, AEC announced revision of its 1966 contract with Kermac Nuclear Fuels Corp., Grants, N.M. miller, which raised the total of completions in contract work to 17. In finishing its new contract with Kermac, AEC shaved an estimated $37-million off an original total commitment of $302-million by "renegotiation".

It is now obligated to purchase $237-million worth of concentrates (as of Nov. 1, 1960), involving delivery of 31,027,000 lb of U_3O_8 in that concentrate. The figures are further reconciled by the fact that AEC accepted deliveries of substantial amounts of concentrate from Kermac between July 1, 1960 and Nov. 1, 1960 date. (See list.)

In making its announcement on contracting, AEC broke a silence of many years surrounding what price it is paying individual millers. It is on March 31, 1962 that the historic Circular Five procurement program which powered the uranium boom of the 1950's comes to an end.

AEC said that of the $1.5-billion in contracting already completed to Dec. 31, 1966, and not counting Kermac's revised contract, some 74,307,-000 lb U_3O_8 valued at $621.3-million would be delivered prior to April 1, 1962.

Some 116,367,000 lb U_3O_8 at $931,500,000 would be delivered after March 31, 1962.

The formal end of the AEC's mine bonus program came in 1960. AEC records to date show that it had paid out $17.5-million on about 5.5-million lb of U_3O_8 since the start of program in March 1951, and its end on March 31, 1960. Some $300,000 will be paid out in conclusion of the program on properties still certified as eligible.

The number of producing mines in the U.S. dropped from 641 as of July 1, 1959 to 598 on July 1, 1960. Oddly enough, the actual number of shippers increased from 390 in mid-1959 to 400 on late date last year.

During fiscal 1960, AEC prices for concentrates bought from private millers in the U.S. was $8.78 a lb. But other costs, including handling, sampling, assaying, residual bonus payments, etc. hiked the total procurement costs to the Government to $8.99 a lb. Similarly, the price to suppliers of U_3O_8 produced in private mills in 1959 fiscal year was $9.18 a lb and actual procurement cost to AEC at $9.40 a pound.

In contrast, AEC said its procurement cost for Canadian concentrates increased from $10.87 to $11.04 a lb in fiscal 1960. Overseas procurement costs increased from $11.84 a pound in fiscal 1959 to $12.01 in fiscal 1960. AEC attributed the latter increases to currency exchange and higher operating costs in foreign areas for which there are escalation provisions in contracts with the foreign producers.

It is projected that procurement cost of domestic uranium concentrates to AEC in calendar 1961 will be in the range of $8.50 a lb.

AEC bought $297.8-million worth of concentrates from domestic sources in fiscal 1960 versus 1959's $285,168,000. It bought $296,796,-000 worth from Canada, versus $293,-618,000 in fiscal 1959 and $109,852,-000 versus $110,294,000 from overseas sources.

During 1960, the U.S. Public Health Service announced it had found "evidence" of lung cancer in uranium-vanadium miners in the Uravan Mineral Belt. A number of Colorado mines were closed last year because of inadequate ventilation.

There was, as yet, no evidence of lung cancer in employes of the "new" mines in Utah, Wyoming, Arizona and New Mexico, and ventilation seemed to be the answer. However, it was apparent that both state and Federal authorities were committed to move determinedly on this matter in 1961.

Those smaller uranium mines which cannot afford the type and character of ventilation required will be boarded up. This could affect other operators in the Uravan Mineral Belt as investigations continue.

During 1960, the AEC announced there would be established a program operating on a "historical basis" for the small miners on the Uravan Mineral Belt. It is tailored to meet the needs of those miners who could not establish sufficient reserves as of Nov. 24, 1958 to carry them into the 1966 purchase program.

AEC said at its Grand Junction Operations Office that its ore reserve allocation and mill concentrates procurement plan was based solely on the miner, indicating that it regarded the miller as occupying a sort of service position.

The agreement to purchase ores under Circular Five arrangement and later concentrates from Petrotomics Corp., Shirley Basin area, caused a furor in some areas of Canada and the U.S.

Some operators said this was an "expansion" in a period of curtailment for others. However, AEC pointed out that the Shirley Basin deal was predicated on an early announcement that it would provide some limited expansion of facilities based on reserves established prior to Nov. 1, 1958. END

Copper

George H. Cleaver

CONCERN pervaded the copper industries as 1961 began. Free World production was well above consumption, and even when net exports to the Soviet Bloc countries are included, a surplus remains. Prices in and outside the U.S. eased late in 1960 and in January 1961, and expectations of further drops were voiced by some buyers and sellers. But in the copper industries the opposite of the expected often occurs.

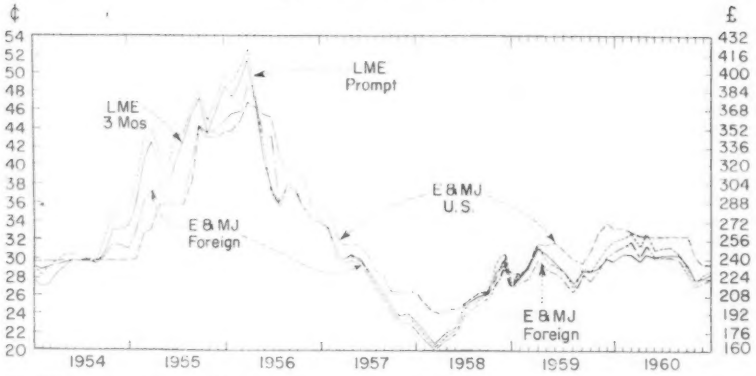
1960 was not a bad year for copper, though some firms, including a number of fabricators in the U.S., did not have easy going. The average price for copper in the U.S. was 32.053c per lb f.o.b. plant. From those who had metal to sell all year few complaints are heard. U.S. consumption by fabricators in 1960 was only about 8% under 1959. It was higher in 1960 than in 1958, about as high as in 1954 and almost as high as 1957. Fabricators in 1960 used 1,237,-469 short tons of primary copper. In 1959 consumption was 1,347,000. The record year was 1955 with 1,418,000 tons.

Deliveries to buyers outside the U.S. in 1960 were far above any previous year. Consumption also was exceptionally high, though possibly not correspondingly so. Prices outside the U.S. were about 1c above 1959 and were satisfactory.

Strike losses for a number of companies reduced the extent to which they shared in the above described favorable situation.

The heavy deliveries to fabricators outside the U.S. in 1960 may be the basis for trouble in 1961. The amount by which fabricators — and perhaps their customers—built up stocks is not known. The belief is current and

Copper Prices 1954-1960



Monthly averages. E&MJ weighted averages are computed from actual reports of sales to E&MJ — normally 140,000 to 17,000 tons per month. LME prices are the average of the mean of the bid and asked; they refer to long tons. The two scales are equal at an exchange rate of $2.80 per £, £320 is 40¢ a lb. etc. Data through December 1960.

widely held that buyers, fearing the Katanga trouble, and to a lesser extent, Chilean labor problems, had built up their inventories to the highest level in many years. If this thesis is true, then the copper markets could seriously weaken in 1961. But many things could strengthen them—including the very things that caused the original weakness. The trouble in Katanga, for instance, is not over.

If it is true that fabricator inventories are high, it does not follow that copper consumption and prices must fall. Some moves were made by large copper producers in mid-1960 to cut output—and additional sharp reductions, (voluntary or involuntary) could turn the market around. If the U.S. economy picks up, and business conditions elsewhere continue at present levels, further reductions in copper output could raise prices in Europe to 30c and might put them a little above that in the U.S.

Dissatisfaction with copper pricing policy was hardly abated in 1960 and may continue in 1961. The London Metal Exchange continued to be the major pricing device for sales in Europe. All kinds of events and rumors of events continued to upset the LME, though its movements were less extreme than in earlier years. This not only reflected the market for copper; but reflected events that had no direct effect on copper markets.

Some fabricators suggest that stability of copper prices is most important, yet many European copper fabricators seem to prefer the instability of the LME copper quotations.

There were indications that fabricators might be less willing in the future to have copper prices tied to such an unstable mechanism. Some were clearly displeased with sharply moving prices.

Unstable prices can be especially harmful to some of the underdeveloped countries for which income from copper mining makes up a large part of the national income. Sharp swings in income can create great domestic unrest and play into the hands of those working to undermine free institutions.

The London Metal Exchange could continue as a hedging mechanism while copper sellers sold at more stable prices. Willingness on the part of fabricators in Europe to see the problems of copper producers and copper producing areas, and greater realization of the benefits to the fabricators of more stable prices, may yet lead to copper prices whose variations would reflect actual changes in long term and intermediate term supply and demand. Acceptance of such a view by fabricators would lead to greater willingness by producers to carry heavier stocks. This would tend to reduce the extent to which boom economic conditions or involuntary restrictions on output pushed up prices.

Copper pricing in the U.S. was little changed from 1959, and 1961 showed small chance of change. Producers continued to sell with the producers' price on the date of shipment. Most custom smelter copper was sold at flat prices though some was also sold at the E&MJ average. Dealers sold mainly at flat prices and were above other sellers when the market was tight; they were below when the

United States Copper and Brass Mill Shipments

(Millions of lb gross weight)

	Sheet	Wire	Rod	Pipe, tube,	Total
Copper					
1956...	223	9	88	418	737
1957...	190	6	67	381	644
1958...	146	5	51	416	618
1959...	183	7	63	488	742
1960...	**169**	**6**	**53**	**440**	**668**
Brass and Other Alloys					
1956...	526	88	489	158	1,261
1957...	471	78	391	142	1,081
1958...	401	73	329	117	920
1959...	512	97	433	122	1,163
1960...	**409**	**72**	**338**	**109**	**928**

Data from Copper and Brass Research Association.

Excludes data from wire and cable mills.

United States Brass and Bronze Ingot Shipments

(Short tons, gross weight)*

1955	314,100
1956	288,500
1957	261,400
1958	227,607
1959	274,562
1960	**235,732**

*About 75%–80% is copper.

Source: Council of the Ingot Brass and Bronze Industry.

Copper Statistics (a)

(Thousands of short tons)

U. S.	1960	1959	1958
Output			
Mine	**1,138**	806	1,008
Secondary (b) (i)	**395**	447	411
Refined	**1,675**	1,222	1,447
Imports (c)			
Ore, etc. (h)	**80**	82	93
Blister (h)	**300**	269	268
Refined (h)	**145**	214	128
Net imports (ore, blister, refined) (c) (h)	**90**	403	94
Net imports, semi-mfg. (c) (h)	**59**	65	51
Net exports, scrap (h) (c) (j)	**149**	29	38
Exports, refined (c) (h)	**425**	159	385
Stocks, ref., Sellers	**139**	65	81
Del. to fabricators	**1,279**	1,312	1,179
Del. by fabricators (d) (h)	**1,250**	1,348	1,166
Fabricator stocks (end of year) (d) (h)	**446**	415	446
Apparent Consumption (e) (i)	**1,115**	1,176	1,157
Actual Consumption (f) (i)	**1,350**	1,446	1,257
Free World			
Mine Output	**3,525**	2,860	2,713
Refined Output	**3,697**	2,927	2,811
Refined del. to fabricators	**3,607**	2,973	2,918
Stocks, ref. producers	**428**	293	263
Prices, per lb., in U.S. cents			
E & MJ U.S., f.o.b.	**32.053**	31.182	25.764
E & MJ Foreign, c.i.f.	**30.839**	29.837	—
L.M.E. current month	**30.745**	29.720	24.673
L.M.E. 3-Month	**29.852**	29.264	24.650

(a) Unless otherwise indicated, based on Copper Institute data. An estimated 400,000 short tons of Free World copper production (all outside the U.S.) is not reported to the C.I. An estimated 550,000 produced outside the Free World is also excluded. (b) From old scrap, alloyed, unalloyed and other, based on Bureau of Mines data. (c) American Bureau of Metal Statistics. Based on U.S. Census Bureau data. (d) Based on copper Association data. Stocks include refined metal, metal in process, metal in products and in inventory. (e) From U.S. Bureau of Mines. New refined copper withdrawn from year's total supply on domestic account. (f) From U.S. Bureau of Mines; actual reports from fabricators and foundries. (h) December 1960 estimated. (i) December and November 1960 estimated. (j) Estimated copper content.

market was soft. Sellers and buyers were generally satisfied with the pricing policies used in the U.S.—at least any dissatisfaction by either buyers or sellers was minor compared with Europe. For 1960, the average delivered price in the U.S. was above the LME spot price by about the amount of the U.S. import duty, 1.7c per lb. The same was true in 1959.

Steamed-up research and promotion by the copper industries is in prospect for 1961. The Copper Products Development Association, composed of 31 U.S. and other copper producing companies, got a number of research projects under way in the past year. The association was set up to do technical research and promotion in order to increase the use of copper in industrial and consumer fields. Its intent is to find new markets for copper, new uses that take advantage of copper's unusual physical qualities and appearance, to promote old uses and develop public and industrial interest in the metal.

Copper is a rather homogeneous product, and therefore there is limited opportunity for producers to get a significant share of the market through product differentiation. Copper is therefore a product in which applications research can be done cooperatively by many companies.

Dr. Charles H. Moore, technical director of CPDA, said in September 1960 that the 1961 research program will be concerned with four types of research projects:

1. Copper as a chemical raw material—projects will be designed to take advantage of the copper ion's affinity for non-metallic ions and its notorious tendency to migrate.

2. Copper as a mechanical material—projects designed to yield products that are unaffected by the copper ion's activity.

3. Surface chemistry—projects designed to suppress or render ineffectual the activity and mobility of the copper ion.

4. Atomic chemistry — projects aimed at the structural modification of the basic copper atom.

Some of the research projects under way are: development of stainless copper by metallurgical surface treatment, development of organic coatings for interior and exterior protection, protection of copper by organic and inorganic films, an engineering survey for new or expanded uses for copper in the transportation industry, a survey for uses in the construction industry.

Newer projects include study of catalytic action of copper in engines, copper containing catalysts for catalytic afterburners, of organometallic fuel additives as catalysts, the feasibility of anodic treatment of copper alloys, investigation of the mechanics of the surface reactions of copper, an engineering survey for new uses for copper in the electrical industry, effect of copper on the corrosion of pearlitic cast iron by sulphuric acid.

Various research organizations are doing the above work with f ; from CPDA. Individual companies continue to do research in the fields of copper application about which they are most concerned.

Recapture by copper and brass of a number of uses from other materials has been reported by the Copper and Brass Research Association.

Troubled days for production cannot be written off for 1961, though prospects do not look as bad as they were for 1960 and 1959. The main difficulty still appears to be the Congo. The Katanga area had been less involved in the fighting than other areas, but in January 1961, Lumumba troops entered the province. The situation still seems so explosive that predictions of the Congo's future are worth little. During the height of the trouble in 1960, output was interrupted; but when it appeared that Katanga was largely free of uncontrolled violent forces, technical staffs returned and production was quickly resumed. It now appears that the forces for freedom are in the ascendancy. This is likely to continue and chances are good Katanga copper may remain on world markets.

Strike prospects are fewer this year than they were for 1960 or 1959. Fewer important labor-management contracts end this year.

Strike losses were rather heavy in 1960. The strike against most copper producers in the U.S. that began in the summer of 1959 continued into 1960. The last of these was settled about March 25 when Phelps Dodge reached agreement with the union that represents workers at its refinery on Long Island. About all of the mine strikes were settled by February. Though Kennecott had settled with most of its unions months earlier, three craft unions had held out; these finally reached agreement in February. Other important strikes were ended in February. Anaconda and Mine-Mill reached agreement at Great Falls, Butte and East Helena. The White Pine strike also ended.

According to Copper Institute figures, primary U.S. output in January and February together was about 50,000 tons under an approximate "normal", and refinery output for these two months was down perhaps about 75,000 tons.

Copper Mine Capacity

(Thousands of short tons, annual rate)

United States

	Company or Mine		Capacity change	Capacity
1959				1,277
1960	Kennecott—Ray		15	
	Duval—Esperanza		5	
	Banner—Palo Verde		1	
	Transarizona Resources		1	1,299
1961	Kennecott—Ray		5	
	Inspiration—Christmas		3	
	Bagdad		5	
	Banner—Palo Verde		3	
	Transarizona Resources		4	1,318
1962	Inspiration—Christmas		15	
	Bagdad		2	
	Asarco—Mission		30	1,366
1963	Asarco—Mission		15	1,381

Outside U.S.

1959				2,713
1960	Canada:	Campbell Chibougamau	3	
		Opemiska	10	
		Copper Rand	10	
		Phoenix	1	
		Kam Kotia—Viola Mac	1	
		North Coldstream	8	
	Chile:	Anaconda—El Salvador	78	
		Montos Blancos	8	
		Misc. and Small	4	
	Peru:	Southern Peru	140	
	Nicaragua:	Rosita	3	
	Haiti:	Halliwell	4	
	Philippines:	Atlas	3	
		Philex	2	
	Israel:	Timna Valley	3	
	Northern Rhodesia—Bancroft		16	
	Congo:	Katanga	20	
	Uganda:	Kilembe	2	
	So. Rhodesia—Molly		3	
		Alaska	1	
	Australia:	Mt. Isa	15	3,047
			334	
1961	Canada:	Campbell Chibougamau	4	
		Opemiska	(4)	
		Willroy	2	
		Atlantic Coast	4	
		Craigmont	8	
		Kam Kotia—Viola Mac	2	
		Pronto—Pater	3	
		Mine Depletions	(4)	
	Chile:	Penaroya	4	
		Montos Blancos	10	
		Misc. and Small	4	
	Haiti:	Halliwell	6	
	Yugoslavia:	Majdenpek	12	
	Japan:	Dowa	6	
	Congo:	Katanga	35	
	Uganda:	Kilembe	2	
	So. Rhodesia—Alaska		3	
			97	3,144
1962	Canada:	Opemiska	(1)	
		Atlantic Coast	2	
		Craigmont	8	
		Mine Depletions	(15)	
	Chile:	Anaconda—El Salvador	(20)	
		Penarroya	10	
	Peru:	Other Small	2	
	Nicaragua:	Rosita	4	
	Yugoslavia:	Majdenpek	13	
	No. Rhodesia—Mufulira		23	
			26	3,170
1963	Canada:	Mine Depletions	2	
	Chile:	Kennecott—Braden	50	
	Peru:	Southern Peru	(20)	
	No. Rhodesia—Mufulira		35	
		Chibuluma	2	
			65	3,235
1964	Chile:	Kennecott—Braden	50	
	No. Rhodesia—Chibuluma		3	
			53	3,288

Free World Totals

1959	3,990
1960	**4,246**
1961	4,463
1962	4,536
1963	4,616
1964	4,668

Figures in parentheses are negative.

until Nov. 15 that workers were back on the job. Meantime there had been many rumors of settlement. Workers got about a 25% wage increase and various fringe benefits; they had originally asked two or three times that. About 35,000 or 40,000 tons of production was lost.

Kennecott's labor contract at El Teniente in Chile was to expire Dec. 31, 1960. There seemed to be some logic in the view that there would be a strike. Everyone knew the industry was drastically over-producing. Prices had slipped sharply in October and remained low in November. But there was no strike.

This illustrates well that what is (almost) universally expected in the copper industries often does not occur. The year 1960 was a great one for this.

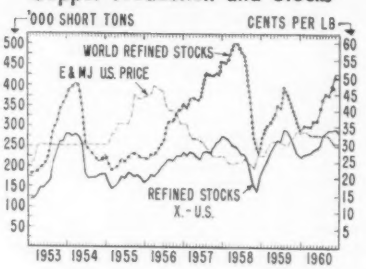
Rhodesian labor-management relations in the copper industry achieved a major break-through in November 1960. The agreement by the European mine workers union to accept African advancement was a step of great significance. The copper companies for long had indicated their view that African workers should not be confined to the lowest paid unskilled jobs. Those that indicated the ability to move into more skilled work should be given the opportunity and with it should be given the chance to get correspondingly higher wages.

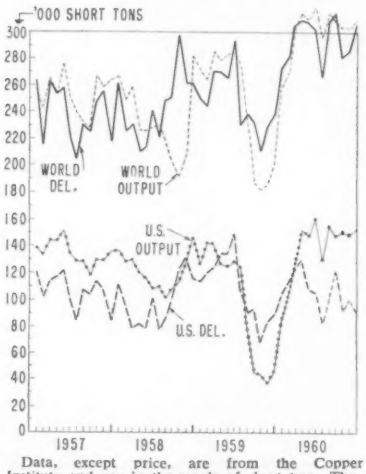
The Mining Joint Industrial Council, consisting of the union executives and the managements of the mines, had worked out the proposals together and the union executives recommended them to the rank and file. A unified wage scale has been set up bridging the gap between the present European and African wage scales. New intermediate jobs were created to fill the gap that had existed between those two scales. Under the new system, merit will be the criterion in choosing a worker to fill any vacancy.

This achievement greatly reduces the major source of labor-management friction in the Rhodesian copper industry. It also provides a basis for easing any difficulties that might arise in connection with future political developments in the Rhodesias.

Prices for 1961 are likely to be lower than 1960. Early in January 1961, London Metal Exchange prices started down; it had become probable that El Teniente in Chile would not be struck. When agreement was reached without a strike a few days later, LME dropped further. The LME spot price had averaged 30.75c in 1960; on Jan. 17 it was about 27.10c.

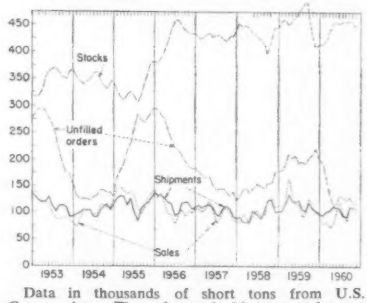
Copper Production and Stocks





Data, except price, are from the Copper Institute and are in thousands of short tons. They include December 1960. World refined output and stocks do not include the U.S.S.R., Japan, the Scandinavian countries, Yugoslavia, and the Mesina Mine in Transvaal. The series "X-U.S." are the above world stock statistics less the U.S. No fabricator stocks are included. Beginning with Jan. 1960 the C. I. includes data for mines formerly excluded.

U.S. Copper Fabricator Data



Data in thousands of short tons from U.S. Copper Assn. The sales and shipment series are related only to purchases of refined copper by the fabricators, including copper refined by custom smelters from their intake of scrap and concentrates. All statistics refer to brass mill, wire mills and foundries. All series are for fabricated products except stocks which are of refined copper and copper in process. November is the last month indicated. Sales and shipments series are two months moving averages.

Copper was in rather short supply early in 1960 owing mainly to the industry-wide strikes in the U.S. late in 1959 and early 1960. This had kept the price up (along with high consumption outside the U.S.). The rioting and political troubles in the Congo contributed to the rather high prices in the first half of 1960.

Prices eased somewhat late in February 1960. U.S. producers were starting to get back into production and some consumers thought they would soon be getting U.S. producer metal. During most of March, U.S. custom smelters were down to 33c. By the end of March, some merchants in the U.S. were suggesting 31½¢. Prices in April recovered somewhat in Europe, eased in May, moved up some in June. In late July, London spot started down from 32c and, with minor interruptions, continued down to about 27½¢ at the end of October. This drop reflected the reduced demand in the U.S. and the notion that output interruptions in Chile and (perhaps) the Congo would not be enough to prevent a copper surplus. In London, copper firmed some in November, but it slid in late December.

Custom smelters in the U.S. dropped to 31¢ delivered from 33¢ Oct. 3. U.S. producers held to 33¢ until Oct. 12. Kennecott took the lead but did not stop at 31¢—it cut 3¢ to 30¢. The next day all U.S. smelters and producers were quoting the 30¢ price.

Slow buying in the U.S. and heavy production there and elsewhere had cooled down the market. Sellers took some action, even though Anaconda had a strike on in Chile. Phelps Dodge said it would cut output to 90% of capacity from the 94% at which it had been operating. Noranda in Canada had begun cutting back earlier. The Rhodesian Selection Trust group said it was reducing output 10%—this is about 2,000 short tons per month, and Anglo-American announced it would either cut output 10% or hold that amount off the market. Katanga in mid-October said it was cutting output 10%—about 2750 short tons a month. These cuts total about 9500 short tons a month. Though the only place, up to that time, where demand had slacked off significantly was the U.S., the U.S. cut-backs were less than 10% of the total reduction. But some would say U.S. producers took their cuts earlier via strikes.

Many "ifs" lie between January and December 1961. One's judgement on copper prices and markets depends on his view mainly of the following matters: will the U.S. economy come out of its slump; will economic conditions continue strong outside the U.S.; will copper producers cut output further, and if so, will they cut enough to prevent the surplus from growing; will involuntary cuts occur (Congo trouble, strikes); will the United Nations sponsored copper committee (such as exists in lead and zinc) be reconstituted and will it re-

Continued on p 128

Minor Metals

H. A. Tucker
Commodity Specialist
U.S. Bureau of Mines

The silicon market became saturated in 1960; prices dropped sharply; single-crystal sales increased; but miniaturization improvements may curtail expansion of the industry. p 97

Robert H. Lesemann
Assistant Editor, Markets
Engineering & Mining Journal

A major obstacle to widespread acceptance of rare earths is high cost. In 1960 prices were virtually unchanged from 1959. Through expanded research it is hoped 1961 will see more use of rare earths. p 105

Donald E. Eilertsen
Commodity Specialist
U.S. Bureau of Mines

Beryllium demand in atomic energy, aviation and space surged in 1960. Domestic supply remained small. Producers depended on imported beryl, while USBM intensified exploration and research support. p 103

J. P. Ryan
Commodity Specialist
U.S. Bureau of Mines

Platinum sales were high and distribution stable in 1960. Demand for platinum in glass and electrical, and for palladium in electronics and chemical industries should increase in 1961. p 99

F. W. Wessel
Commodity Specialist
U.S. Bureau of Mines

Columbium-tantalum ore imports were slightly greater in 1960 than in 1959. p 98. Zirconium demand was at a low level. p 100. Hafnium was tight p 100

G. Richards Gwinn
Commodity Specialist
U.S. Bureau of Mines

Antimony imports exports and smelter production expanded; primary metal consumption contracted p 96
Bismuth imports and industrial consumption rose. p 96

Peter Colefax
President
American Potash & Chemical Corp.

Boron production figures for 1960 will match those for 1959, mostly thanks to a fourth quarter increase. Major producers have moved into foreign fields. p 106

A. E. Schreck
Commodity Specialist
U.S. Bureau of Mines

Lithium application research showed promise in several new directions; however, 1960 saw some curtailment of production with December termination of AEC contracts. p 101

J. R. O'Connell, Jr.
Market Editor
Engineering & Mining Journal

Mercury prices should be steady in 1961 at current levels. The past year was marked by decreased imports and lower consumption. Resumption of barter is a possibility should business lag. p 108

D. P. Eigo
Managing Editor
Engineering & Mining Journal

Titanium's four-point recovery from the disasters of 1958 is paying off. Prices have been reduced regularly, non-military consumption has grown, new markets found. p 107

H. J. Schroeder
Commodity Specialist
U.S. Bureau of Mines

Cadmium production increased and consumption decreased in 1960. Lower imports and very large exports reduced stocks sharply. Strong world demand is forecast for 1961. p 105

Frank L. Fisher
Commodity Specialist
U.S. Bureau of Mines

Germanium consumption advanced strongly in 1960. Production and imports rose during the year, and prices remained firm. p 104
Selenium activity decreased on all fronts in 1960. p 103

Don H. Baker, Jr.
Commodity Specialist
U.S. Bureau of Mines

Thorium's use in missiles and aircraft continued to increase. Research on applications in atomic reactors has shown progress. Free World production was negligible in 1960. Exploration is being pursued. p 102

Antimony

G. Richards Gwinn

THE DOMESTIC INDUSTRY in 1960 was characterized by a rise in primary and secondary smelter production, imports, exports and stocks, and a slight reduction in mine production and consumption of primary metal. Although no Government purchases were made for the strategic stockpile, barter contracts were executed by the Commodity Credit Corp. to obtain antimony for the supplemental stockpile.

Reported consumption of primary antimony during the first nine months indicated a total of about 13,000 short tons for the year. Consumption declined slightly through the first three quarters with most uses contributing to the decrease, and then sustained an upturn during the fourth quarter. The usual vacation months of July and August at secondary lead plants, (where most of the battery metal is produced) served to reduce the consumption of antimony in metal products during the third quarter to 49% of the total consumed, compared with 51% for nonmetal products. This was the only period of the year when the total consumption in metal products such as battery grids, antifriction bearings, cable sheathing and type metal, fell below nonmetal uses. Battery metal consumption reached its peak in October and November and by year-end metal products regained their position as the largest consumer of antimony; they accounted for about 59% of the antimony consumed in 1960. Antimony alloyed with indium gained importance as an electronic material.

Ceramics and glass, pigments, plastics, and flameproofing chemicals and compounds were the major nonmetal uses. The use of antimony oxide in manufacturing plastics promises a good growth potential for this antimony product.

Smelter production of primary antimony increased about 14% to 10,000 tons. Imported concentrate was the chief source of smelter feed. Substantial quantities of by-product antimony, however, were recovered from lead bullion and other intermediate smelter products. The only domestic mine production of antimony was 650 short tons recovered, as impure cathode metal, as a by-product of the processing of silver-lead ores by the Sunshine Mining Co. in Idaho.

The output of antimony alloys from scrap metal (secondary metal) in 1960 was 21,700 tons, an increase of about 2% over 1959.

Antimony Statistics

(Short tons)

	1960 estimated	1959
Domestic mine production	**650**	678
General imports	**15,000**	13,273
Primary smelter production	**10,000**	8,748
Consumption of primary antimony	**13,000**	13,317
Price, cents per lb	**29.00**	29.00

Imports rose 9% during the year with all classes except sulphide contributing to the increase. Most of the ores and concentrates came from Mexico, Bolivia and South Africa. Shipments of substantial amounts also were received from a new antimony mine recently opened in Guatemala. The United Kingdom, Yugoslavia, Belgium-Luxembourg and France, of the European countries, and Mexico in the Western Hemisphere, were the major suppliers of antimony metal. About 25% of the metal imports represent Government purchases from the United Kingdom and Yugoslavia on barter contracts executed by the Commodity Credit Corp. A smaller percentage of the ore and concentrate imports also came from barter.

Antimony exports (largely re-exports) in 1960, of about 850 tons, were unusually high and compared with 174 tons exported in 1959. Antimony ores and concentrates comprised the bulk of material exported.

The price of RMM brand, 99.5% antimony, f.o.b. Laredo, Texas, quoted at 29.00¢ per pound throughout the year. The New York equivalent price was 31.30¢. Foreign metal, 99% to 99.6%, imported in 10-ton-lots, duty paid, was quoted at 25¾ to 26¢, the exact price determined by grade and origin.

Consumer and dealer stocks increased about 15% to a year-end total of about 7,250 tons. The increase was attributed to larger domestic primary and secondary smelter output, and increased imports, without an attendant rise in consumption. END

Bismuth

G. Richards Gwinn

INCREASED industrial consumption and imports and a decline in consumer stocks characterized the domestic bismuth industry in 1960. Government purchases, through barter contracts executed by the Commodity Credit Corp., were made to obtain bismuth metal for the supplemental stockpile. No purchases were made by the Government for the strategic stockpile.

Production of refined bismuth in 1960, derived from foreign and domestic ores, came almost entirely from metallurgical by-products of lead refining. Metal production is believed to have followed closely the trend in the output of refined lead, which indicates an output about equal to, or slightly above, 1959.

Refined bismuth imports through the first nine months indicate a total in excess of 900,000 lb for the year, an increase of more than 100% over 1959. Peru retained its position as the largest contributor. Mexico, Canada, Yugoslavia and the United Kingdom, in the order named, were the remaining major suppliers. About one-third of the total imports represents bismuth obtained for the supplemental stockpile on Government barter contracts. Peru and the United Kingdom supplied the bismuth obtained under barter contracts, with the former accounting by far for the greater share of the material.

Bismuth Statistics

(Thousands of pounds)

	1960 estimates	1959
Consumption	**1,500**	975
Imports	**900**	457
Exports (includes alloys)		
Quoted price, per lb	**$2.25**	$2.25
Consumers' and dealers' stocks, end of year	**240**	473

Exports of bismuth as metal and in alloys in 1960 were essentially on the same order as in the preceding year —about 180,000 lb. The distribution between metal and alloys is unkown but the continuing decline or static condition of the domestic refining industry and increased domestic demand would indicate a pattern similar to that of the previous year when metal shipments accounted for 25% of exports.

Consumption of 1.2-million lb of refined metal through the first nine months of the year, a 20% increase over the comparable period of 1959, indicates a year-end total of about 1.5-million lb. In addition, an unknown quantity of bismuth contained in imported bismuth-lead bars was consumed directly in alloy fabrication.

Fifty percent of industrial use was in

low-melting-point alloys, valued for their controllable dimensional changes, and bismuth used to improve the machinability of aluminum alloys and malleable irons and steels. About 35% was consumed in pharmaceuticals, including increasingly larger quantities of industrial and laboratory chemical products. The latter products, in 1960, accounted for about one-third of the quantity consumed in pharmaceutical uses. Experimental and miscellaneous uses accounted for the remaining 15% of the industrial uses.

Bismuth telluride is still being considered as a thermoelectric element in the production of semiconductor products, but the quantities required remain small. Considerable success has been reported in the binary thermoelectric bismuth and tellurium elements, but difficulties are still being encountered in the production of ternary elements and, particularly, the new quaternary alloy element composed of bismuth, tellurium, selenium and antimony.

Under pressure of increased consumption, and despite larger imports, stocks of bismuth fell sharply. Metal in consumer and dealer warehouses at year-end was 240,000 pounds—a decline of more than 230,000 pounds from the beginning of the year. (See table at left.) END

Silicon

H. Austin Tucker

IN 1960, several significant events took place in the high-purity silicon business. Most significant was the sharp decline in prices, indicating a saturated market for the first time since the market began an amazing growth in 1956. Also, a larger quantity of silicon was sold by producers as single crystals, making production comparisons with previous years difficult. Two new producers entered the field and one dropped out. Finally, technological progress, including miniaturization, was made, which may curtail further expansion.

Since from 20- to 50% of the polycrystalline production is lost in making single crystal bars, and more producers marketed more silicon as single crystals in 1960 than before, a direct comparison with previous years is difficult. However, on a basis equivalent to that used in 1959, an estimated 90,000 lb of high-purity silicon was produced in 1960 compared to 73,000 lb in 1959. For comparison, production had doubled each previous year since 1956. This slowdown of the rate of expansion in the quantity of silicon produced indicates that the market was glutted.

The saturated market resulted in two large price cuts led by Texas Instruments, Inc. Prices of Grade I polycrystalline silicon declined in 1960 (see table). In like manner, Grade II dropped from $220 to $150 a lb; Grade III, from $130 to $100; and solar grade, from $90 to $80. A tentative further cut in the price of Grade I silicon by a few unidentified silicon makers or reprocessors occurred in September, dropping the price to $175, $150, and $150 a lb, listed in the same order as shown in the above table.

Single crystal silicon also took a price decline of 4% down to 10% in August from the level set in October 1959 (see table).

From an estimated 80,000 lb of silicon sold to consumers, about 8-million transistors and 80-million diodes and rectifiers were manufactured by electronic device makers, compared to 5-million and 53.5-million, respectively, in 1959. Consumption and production totals were nearly equal. Approximately 10,000 lb of solar grade silicon were used, mostly for solar cells, but also in low-performance electronic devices. An unknown quantity of polycrystalline silicon was cast in optical shapes for use with heat-sensing equipment. About 25,000 lb of single crystal was sold by producers, including that for internal consumption of integrated plants. This results in sales of single-crystal silicon alone amounting to about $19-million, whereas polycrystalline sales-value totals about one-half as much.

Considerable activity occurred among producers in 1960. The new producers were Monsanto Chemical Co. with a plant at St. Charles, Mo., and Dow Corning Corp. with a semi-commercial plant at Hemlock, Mich. The latter firm will have completed its commercial plant at Hemlock by early 1961. Both of these producers make silicon by a method licensed by the West German firm, Siemens and Halske, through Westinghouse Electric Corp., the exclusive holder of the rights to the process in the U.S.

In May, E. I. du Pont de Nemours & Co., Inc. announced that it had been licensed by International Telephone and Telegraph Co. to use a new process for making silicon of the highest purity based on the decomposition of silane, SiH_4. This new manufacturing facility is at Du Pont's plant in Newport, Del. Du Pont continues to operate its larger plant at Brevard, N.C. Eagle-Picher Co. discontinued production of high-purity silicon early in 1960. Also, Foote Mineral Co. ceased operating its semiworks facility in Exton, Pa., in April, although it never made silicon commercially. Mallinckrodt Chemical Works, St. Louis, Mo., and Kemet Co., Cleveland, Ohio, began making high-purity silicon in 1958 but were not listed on these pages last year. The remaining six producers of high-purity silicon are International Metalloids, Inc., Sylvania Electric Products, Inc., Allegheny Electronic Chemicals Co., Trancoa Chemical Corp., Merck & Co., Inc., and Texas Instruments, Inc.

The trend toward miniaturization has continued with promising developments. The most promising is the growth of a thin layer of single crystal silicon upon a single crystal substrate by vapor deposition. This process has been variously called atomic bricklaying, molecular electronics, molectronics, and more specifically, epitaxial growth. The latter term, epitaxial, means that each successive layer of silicon deposited assumes the struc-

Single-Crystal Silicon

Resistivity in ohm cm		Price per gram	
Type N	Type P	August 1960	October 1959
below 0.09	below 0.09	$1.59	—
0.1–50	0.1–100	1.39	$1.55
51–100	101–200	1.59	1.71
101–500	201–1000	1.79	1.875

Polycrystalline Silicon

Month 1960	Less than 25 lb	More than 25 lb	More than 100 lb
January	$330	$330	$300
February	270	270	260
July	210	210	200

ture of the single-crystal shape serving as a substrate, or support. Chief proponents of this technique are Merck & Co., Inc., and the laboratory of International Business Machines at Poughkeepsie, N.Y. The latter company has done much of its work on germanium, however.

The common feature in the several variations of depositing silicon from the gas phase is a hot, single-crystal substrate, exposed to an atmosphere charged with a silicon compound such as silane, SiH_4. Depending upon which silicon compound is used, the substrate is heated to a temperature between 700° and 1300°C. Linear, epitaxial growth rates vary from 15 to 320 microns per hour.

Because epitaxially grown crystals can be doped while building, a great variety of electrically active regions can be formed. This means, for example, that silicon transistors can now be made with switching speeds comparable with those of germanium. This improvement would permit the use of silicon transistors in electronic computers; however, germanium is still in a better competitive price position. Currently, gold-doped single crystals are popularly used to make fast-switching devices, because they shorten the life-time by permitting the crystal to become quickly saturated.

Another avenue of attack toward miniaturization is that made by Texas Instruments. With its "Solid-Circuit" semiconductor network ideas, it has assembled several dies, variously etched, doped and interconnected in a device that measures only 0.250 x 0.125 x 0.031-in. In effect it is a potted component of electronic circuitry that contains the equivalent of 16 conventional components. Other technological changes have gradually occurred that tend to curtail production of silicon but are not as dramatic as device miniaturization. Single-crystal makers have greatly improved their products in the last two years. Since single-crystal rods are now more uniform electrically from end to end and from the surface to the center, technicians can measure their electronic characteristics more accurately; therefore, they can use the rods more intelligently. Until recently only 10% of a rod was usable, now all single-crystal makers produce rods from which up to 60% of the material is used. Perhaps 40% of a rod is lost in sawdust created in making slices; thus all available material in most of the rods now produced is fabricated into electronic devices.

Economies are being effected in using lower grade material for low-performance devices. Some device makers are even buying solar grade material and upgrading it sufficiently for a particular device design.

The tunnel diode that first appeared on the market late in 1959 and threatened to displace conventional devices and to curtail silicon production has not performed as expected. Because the junction between the two sides of the diode is only about 100 atoms thick, early breakdowns have occurred.

The infrared applications of silicon have not developed as rapidly as was hoped by manufacturers. One promising use was in the nose of rockets with heat-sensing guidance for homing on hot objects. This use is satisfactory until the rocket travels fast enough for the nose to become heated to 500°C., at which temperature the silicon window becomes opaque to infrared radiation.

The high-purity silicon business has now reached maturity with the saturation of the market. The production base is broad, with eleven producers who have developed at least four processes for making silicon. Competition among them is keen, prices are dropping, and the pressure is high to develop new uses for silicon. Operating against greater demand are technological improvements that reduce waste and miniaturization that reduces quantity. The greatest hope is a more rapid replacement of the vacuum tube in electronic equipment, and new, high-volume uses. END

Columbium-Tantalum

F. W. Wessel

NO COLUMBIUM-TANTALUM ores were produced in the U.S. during 1960. During the first months of the year, imports of columbium-mineral concentrates amounted to 1,923 short tons, compared with 1,330 and 1,072 tons, respectively, for the same periods of 1959 and 1958. During the same period, 257 tons of tantalite were imported, compared with 251 and 461 tons during the corresponding periods of the previous two years.

Domestic production of first-reduction columbium metal is estimated in 1960 to have increased about 75% over 1959. Production of primary forms of tantalum is estimated at 120 tons, about the same as in 1959.

E. I duPont de Nemours & Co., Inc., was reportedly continuing exploration at its Powderhorn, Colo., pyrochlore deposit. Overseas, columbium sources in several countries were in various stages of development. The pyrochlore deposit jointly held by Wah Chang Corp. and Molybdenum Corp. of America at Araxa, Brazil, was said to be less than three months from the production stage. Several operations in the Oka district in Quebec were building toward production within the next 18 months, although Nova Beaucage Mines Ltd., in Ontario, announced suspension of plans to operate, pending improvement in the market. Large new columbium orebodies in the Congo were discovered and examined. New tantalite activity was limited to minor operations in the Republic of Korea and in Western Australia.

The Federal stockpile inventory equals or exceeds present basic and maximum objectives in both metals; in addition, there are 1,660 tons of non-specification grade columbite and tantalite and about 21,000 tons of low-grade tin slag, which may be disposed of in the near future.

Principal producers of tantalum during 1960 were Fansteel Metallurgical Corp., at Muskogee, Okla., and North Chicago, Ill., and Kawecki Chemical Co. at Boyertown, Pa. Other producers included National Research Corp., Union Carbide Metals Co., Wah Chang Corp., and Kennametal, Inc. Wah Chang Corp. was the major producer of columbium; other producers included E. I. duPont de Nemours & Co., Union Carbide Metals Co., Kennametal, Inc., and Fansteel.

Demand for and production of ferrocolumbium and ferrotantalum-columbium increased slightly during 1960. Union Carbide Metals Co. and Shieldalloy Corp. were the principal producers of both alloys, while Molybdenum Corp. of America, Vanadium Corp. of America, Reading Chemical Co., and Wah Chang Corp. produced only ferrocolumbium. Vanadium Corp. introduced Thermocol, and exothermic ferrocolumbium, about mid-year.

Stauffer Chemical Co. in July announced the availability of columbium and tantalum chlorides in quantity.

Prices increased for columbium concentrates early in the year; columbium in a 10:1 ratio closed at $1.18 to $1.25 per lb of contained pentoxides, and the 8½:1 material at $1.05 to $1.10.

Tantalite sold early in the year at $4.80 per lb of contained oxide for 60% concentrate, but closed in the range of $7 to $7.50. Owing to the unsettled conditions in the Congo, the upward pressure on tantalite prices during the last six months is expected to continue.

1960 Cb-Ta Prices

(At year's end; $-per-lb)

	Columbium	Tantalum
Powder, capacitor—grade	—	$47.50-$50
Powder, technical—grade	$30-$40	$30-$40
Ingot	$35	$45
Sheet	—	$50-$59
Rod	—	$73-$80
Oxide	$6.25	$13.50
Carbide	$22.50	$20-$22.50
Chloride	$5	$10

Prices of most forms of tantalum and columbium metal and compounds were reduced during 1960, as shown in the accompanying table.

Ferroalloy prices remained unchanged during the year at $3.05 per lb contained columbium plus tantalum for ferrotantalum-columbium, and $3.45 for ferrocolumbium.

Wah Chang Corp. contracted with Pratt & Whitney Aircraft Division, United Aircraft Corp., to supply over $1-million worth of columbium in various forms.

Technological advances during 1960 included Battelle Memorial Institute's development, on behalf of Nova Beaucage Mines Ltd., of a process for hydrogen reduction of columbium pentachloride in a fluid-bed reactor to produce metallic columbium. Naval Research Laboratories developed a method for protecting columbium from high-temperature oxidation by coating it with zinc. Other research in similar areas is continuing.

The outlook for columbium is favorable. The development of ore deposits on a world-wide scale assures sufficient raw material supply. The application of small quantities of columbium to ordinary carbon steels, pioneered during 1960, holds promise for increased ferrocolumbium demand. Additional columbium-base alloys are being developed—notably the columbium-uranium alloy for use as fuel rods in atomic reactors. Fabrication techniques, particularly using the electron-beam furnace, are advancing rapidly. It seems probable that columbium and its alloys will soon be the preferred material for structural applications at 1000 to 1400°C. The near-term outlook for tantalum is shadowed by uncertainties of ore supply; however, the expansion in technology and use of the 90-tantalum-10-tungsten alloy, developed in 1959, is an element of strength, and tantalum's long-term future seems well-assured.

END

Platinum

J. P. Ryan

U.S. DEMAND for platinum metals continued at a high level in 1960 and sales to consuming industries may establish a new record, notwithstanding the slump in business activity during most of the year. Except for considerable trading activity early in the year, market conditions for platinum metals remained stable wth little or no change in quoted prices. U.S. imports and refinery production of platinum metals dropped, but domestic mine production and exports were substantially higher. Free World mine output of platinum metals also increased during the year and stocks of refined metals at year-end rose moderately.

The pattern of domestic supply of platinum metals remained essentially unchanged from preceding years; the bulk of domestic requirements, which normally comprise more than two-thirds of the world output, was furnished from Canada, Union of South Africa and the Soviet Union. Most of the metals originating in South Africa were imported to the U.S. from the United Kingdom, where they are refined. Platinum metals of Soviet origin were imported either direct from the USSR or through other European countries. Domestic sources of platinum metals, comprising placer deposits in Alaska, by-product metals from gold and copper refining, and secondary metals recovered by refiners, furnished less than 15% of domestic requirements.

Platinum-Group Statistics

(Thousands of troy oz)

	1960 9 months	1959 9 months
Platinum Group:		
Imports	**550.0**	738.9
Domestic refined	**88.4**	129.4
Domestic consumption	**577.2**	558.5
Platinum;		
Domestic sales and exports	**282.6**	248.5*
Imports and domestic refined	**278.1**	314.1
Palladium:		
Domestic sales and exports	**312.9**	309.1*
Imports and domestic refined	**316.9**	503.1
Iridium, Osmium, Rhodium, Ruthenium:		
Domestic sales and exports	**28.2**	30.0*
Imports and domestic refined	**43.4**	51.2

Revised figures.

Canadian production of platinum metals, recovered as by-products of nickel and copper refining, is estimated to be somewhat higher than last year's output as operations of the principal producer, International Nickel Co., continued at a high level through the year. Rustenburg Platinum Mines Ltd. in the Union of South Africa, the world's leading producer of platinum metals, increased the scale of its operations and expanded output of platinum metals to meet sustained demand and to build up its metal stocks. Based on the high-level scale of operations of the two largest producers and the continued high level of exports from the Soviet Union, world production of platinum metals in 1960 is estimated to have increased about 10% to approximately 1.1-million oz distributed as follows: Union of South Africa, 430,000; Canada, 350,000; Soviet Union, 275,000; Colombia, 28,000; U.S., 17,000.

Increased demand by electrical consumers and glass manufacturers accounted for most of the gain in platinum sales. The quantity of platinum used for jewelry and decorative purposes dropped sharply, but dental and medical requirements were higher; sales to chemical consumers remained virtually unchanged. Palladium consumption was slightly higher as increased sales to chemical consumers more than offset lower sales to electrical and electronic equipment manufacturers. Palladium sold for dental and medical uses increased slightly, offsetting lower sales for jewelry and decorative purposes.

Platinum sales by domestic refiners and dealers to consuming industries in the first nine months of 1960 aggregated 249,400 oz, of which 35% was absorbed by chemical industries including petroleum refining; 32% in electrical industries; 21% in glass manufacturing; 8% jewelry and decorative; 3% dental and medical; and 1% for miscellaneous uses. The official price per troy oz of platinum rose from a range of $77-$80 to $82-$85 in January and remained virtually unchanged thereafter.

Palladium sales to domestic consumers for the first nine months were 300,900 oz, about two-thirds of which was absorbed for electrical and electronic uses; 20% for chemical uses; 6% dental and medical; 6% jewelry and decorative, and 2% for petroleum refining and miscellaneous uses. The official price per ounce of palladium

was advanced from $22-$24 to $24-$26 in January and remained unchanged thereafter.

Domestic refiners and dealers reported sales of the minor platinum metals, iridium, osmium, rhodium, and ruthenium aggregating 26,900 oz for the nine-month period, a drop of 7% from last year. The price of iridium was lowered from $75-$80 an oz in January to $70-$75 in October and remained unchanged thereafter; osmium was unchanged during the year at $70-$90 an oz; the price of rhodium was raised from $122-$125 to $137-$140 an oz in January and remained unchanged thereafter, and the price of ruthenium per ounce dropped from $55-$60 in January to $45-$50 in October, advancing again to $55-$60 near the end of the year.

Industrial demand for platinum metals should continue at a relatively high level with no significant changes in market prices likely in the near-term future, assuming continuation of the orderly selling policy of the USSR. The general rising trend in comsumption of platinum in the glass and electrical industries may offset any further decline in demand from petroleum refiners. Demand for palladium and palladium alloys from chemical and electrical consumers should continue to rise slowly, as recently developed chemical and electronic applications are adopted. Free World production, supplemented by shipments from the Soviet Union, should continue to provide new supplies of platinum metals adequate to meet anticipated demand.

END

Zirconium-Hafnium

F. W. Wessel

DURING 1960, consumption of zirconium metal again was principally for use in atomic-powered naval vessels; non-military use was in the order of 25 tons. The tight hafnium supply situation was recognized and additional procurement contracts placed.

Demand for zircon concentrate was somewhat less than in 1959. A contributory factor to the decreased demand was the unprecedentedly high stocks built up, principally by consumers, by the end of last year. South African zircon captured a somewhat higher portion of the import market, and a little Danish zircon appeared early in the year.

The Australian association of producers of zircon and rutile attempted during the year to limit production and increase prices, but negotiations were reportedly unsuccessful.

Production of zircon in Florida, principally by E. I. duPont de Nemours & Co., Inc., at Highland and Trail Ridge, continued during 1960. The purchase of Orefraction Minerals, Inc., by Metal and Thermit Corp. was a major event. The former company owned and operated a grinding and sizing plant at Andrews, S. C., and in addition acted as sales agent for much of the domestic production. Also noteworthy was the purchase by Corhart Refractories, Inc., of the refractories plant owned by the Corning Glass Works at Corning, N. Y.

In January, GSA asked for new bids for purchase of zircon and baddeleyite, held in the national stockpile but in excess of needs. Additional lots were offered in October. A total of 850 tons of zircon was sold at this time. In June, stockpile inventory consisted of 16,500 short tons of baddeleyite and 13,700 tons of zircon; in addition, there were available 1,700 tons of semi-finished zircon concentrate.

Zirconium Statistics

(Short tons)

	1960 estimate	1959
Zircon:		
Domestic production, short tons	**52,000**	n.a.
General imports, short tons	**36,000**	54,878
Average price	**$46**	$46
Zirconium sponge;		
Domestic production, short tons	**1,425**	1,404
Price, reactor-grade, lb.	**$6.25**	$6.25

Zircon prices remained uniform throughout the year. Imported concentrate sold at $50 per long ton c.i.f. Atlantic ports. Domestic concentrate sold at $47.25 per short ton f.o.b. mines at Starke, Fla.; Jacksonville material was not quoted. Nigerian high-hafnium ore continued to command a premium price of $150 per short ton.

An estimated 1,425 tons of primary zirconium (sponge and chunklets) was produced during the year by Carborundum Metals Co., Columbia-National Corp., Reactive Metals, Inc., and the Wah Chang Corp.

Carborundum Metals Co. continued production of hafnium sponge under its supplemental contract with AEC.

Early in the year, management of the Mallory-Sharon Metals Corp. was turned over to Bridgeport Brass Co. In May, corporate control was realigned; P. R. Mallory & Co., formerly one-third owner of Mallory-Sharon, withdrew to the position of creditor, and National Distillers & Chemical Corp. and Sharon Steel Co. divided control on a 60-40 basis. The new company was designated Reactive Metals, Inc., reviving the name of a former fabricating affiliate, and included the Ashtabula and Niles, Ohio, plants of the former Mallory-Sharon company, and the Huntsville, Ala., plant of Johnston & Funk Metallurgical Corp. The latter was sold shortly thereafter to the Wah Chang Corp. Bridgeport Brass will continue its management functions for Reactive Metals.

The Columbia-National Corp. plant was shut down Dec. 1, 1959, pending corrosion tests on the metal produced. The test program indicated the quality of metal to be satisfactory, and the company resumed production of zirconium sponge in June.

Wah Chang Corp. began work on contracts to supply the AEC with Zircaloy-2 ingot for the Hanford reactor, Zircaloy-2 tubing for the reactor at Hallam, Neb., and hafnium sponge for the Pittsburgh Naval Reactors Operations Office. The latter was made from Nigerian high-hafnium zircon. This company also reportedly began delivery of 10,000 pounds of hafnium to Consolidated Edison Co., under a contract concluded in 1958. The metal was produced by bimetallic reduction and melted in the electron beam furnace.

The Wolverine Tube Division of Calumet & Hecla, Inc., announced plans to build a plant at Inkster, Mich., to fabricate zirconium and titanium tube and rod. Other metals and other shapes will be added as demand develops.

Harvey Aluminum, Inc., began delivery on a contract to provide AEC with 800 zirconium tubes for the Hanford reactor. Each tube contained 400 lb of metal and was extruded to a length of 57 ft. Reported price was $9,000 per tube.

Nuclear Materials & Equipment Corp. began making crystal-bar hafnium at the rate of 11,000 lb annually, presumably from sponge supplied by Carborundum Metals Co. The AEC allotted a total of 7,000 lb of hafnium sponge to Wah Chang and Reactive Metals; these companies will attempt melting and purification in the electron-beam furnace. Wah Chang has also announced a method for the fused salt purification of $HfCl_4$, leading to a high-purity electron-beam-melted ingot.

North American Aviation Corp. is testing the use of zirconium hydride as a moderator; a 300,000-kw. reactor would require 35,000 lb of this material.

A columbium-1% zirconium alloy

is in production; zirconium was added to magnesium and to nickel, forming alloys which entered the production stage. In the refractory field, zirconia and hafnia are being developed for service in the 400° to 4600° F range; Zirconium Corp. of America has expanded its facilities for production of refractory zirconia. A coating of zircon and glass has been applied to tungsten, protecting the latter from oxidation at high-temperatures.

The outlook for zircon in 1961 is for a slight increase in demand, based primarily on recovery in the steel industry. This will not necessarily be reflected by increased mine production or imports, since a large part of the 1959 year-end inventory presumably is still intact.

Zirconium metal production may show a small increase in 1961 if demand for new and replacement fuel elements materializes. Some replacement elements, however, will probably be fabricated from metal which has already been delivered to AEC's current inventory.

Increased demand for hafnium, apparent in 1960, should continue in 1961 and will support continued and possibly increased imports of Nigerian material. The success of the Polaris-carrying submarines makes additional construction authorizations likely. While this may affect the zirconium market in the near future only in the sense of creating a problem of economic disposal of the purified zirconia produced in connection with hafnium production, there seems no doubt that demand for hafnium will continue or even increase further.

END

Lithium

Albert E. Schreck

ALTHOUGH 1960 witnessed no major changes in production or consumption of lithium, the domestic industry continued to express high hopes for the future. There was considerable curtailment in the output of the major producers and no new firms entered the field.

Some of the developments during the year were: (1) The expiration in December of the last of the AEC contracts; (2) Lithium Corp. of America completed consolidation of its production facilities at Bessemer City, N.C., and moved its home office to New York City; (3) Quebec Lithium Corp. placed its lithium carbonate plant on stream.

Domestic production of lithium raw material was again centered in North Carolina. Here, Foote Mineral Co. produced spodumene primarily for conversion to lithium chemicals at its Sunbright, Va., plant. Lithium Corp. of America (LCA) conducted some exploration and development work on its North Carolina spodumene properties but used concentrates stockpiled at its Bessemer City plant for chemical raw material. Maywood Chemical Works, a division of Stepan Chemical Co., continued to recover spodumene from the Etta Mine in South Dakota, and American Potash and Chemical Corp. recovered dilithium sodium phosphate from Searles Lake brines. Total domestic output was at about the same level in 1960 as in 1959.

Mineral imports (spodumene, amblygonite, lepidolite, and petalite) continued to provide part of U.S. domestic raw material requirements, with the Federation of Rhodesia and Nyasaland being the major supplier. For the period January through September, see the accompanying table.

Lithium Imports

(Jan. through Sept. 1960)

Country of origin	Short tons	Value
Argentina.....	110	$ 5,150
Brazil.....	33	1,331
Canada.....	997	49,171
Rhodesia and Nyasaland.....	41,641	1,023,549
Total.....	42,781	$1,079,201

Material from Argentina, Brazil and Rhodesia was primarily for conversion to lithium chemicals; the Canadian and the remainder of the Rhodesian imports were for use in ceramics and glass.

Quantities received from Rhodesia and Canada were considerably below previous years. The noticeable decrease in imports from Canada was due to the termination of the LCA contract with Quebec Lithium Corp. The latter's suit against LCA, for terminating the long-term contract for spodumene concentrates, was settled out of court early in the year. Under the terms of the settlement LCA is to pay Quebec $1.9-million over a 4-year period.

Reduced requirements for lepidolite of American Lithium Chemicals, Inc., was the primary reason for the decline in imports from Rhodesia.

The Quebec Lithium Corp.'s mine remained idle throughout 1960. In the last quarter of the year the firm began trial runs at its new lithium carbonate plant adjacent to the mine. The plant's annual capacity will be about 6-million lb of Li_2CO_3 or its equivalent. Plant feed was obtained from spodumene concentrates stockpiled at the mine. This stockpile also provided the small quantities of ore exported to the U.S.

Bikita Minerals Ltd., Southern Rhodesia's major producer of lithium minerals, did not put its operation on a standby basis, as announced in late 1959. Their acquisition of the adjacent Nolan property permitted them to supply a complete range of lithium minerals to chemical and ceramic and glass consumers.

In the U.S., no new firms entered the highly competitive lithium field. Domestic chemical and metal manufacturers operated considerably below plant capacity.

LCA and U.S. Borax and Chemical Corp. entered into an agreement by which the latter firm will serve as sales agent for lithium compounds used in the ceramics and glass industries.

LCA also completed early in the year the transfer of its production facilities for bromide, chloride, metal, etc., from St. Louis Park, Minn., to new quarters adjacent to its Bessemer City, N.C., plant. The head offices of the firm were moved from Minneaplis to New York City.

Foote Mineral Co. announced that it was building at New Johnsonville, Tenn., a plant capable of producing 100,000 lb of butyl lithium annually.

The last contract for lithium hydroxide between AEC and American Potash and Chemical Corp. expired in December. This made available for commercial markets the entire capacity of the domestic lithium industry.

Associated Lead Manufacturers Ltd., in England, added lithium chloride to the line of lithium compounds it manufactures.

Lithium minerals continued to be consumed primarily in the ceramic and lithium chemical industries. Consumption was at about the same level as in 1959. Lithium compounds were used in multi-purpose greases, ceramics, air conditioning, welding and brazing compounds, catalysts, and metallurgy.

The use of lithium metal in degassifying certain stainless steels and copper; the use of aluminum alloys containing small percentages of lithium in some military aircraft, and other metallurgical applications offer much potential to the industry.

While research during the year revealed many possibilities for increasing lithium's uses, none developed

commercial markets. One promising use is the addition of lithium compounds to the aluminum cell bath. Investigations into the use of lithium in rocketry and as a liquid coolant continued. Early results appear promising; however, numerous obstacles must still be overcome.

While 1960 was not one of the better years for the lithium industry, it showed some promise for better conditions ahead. The coming years will probably provide some increases in commercial consumption and could result in some potential uses gaining commercial acceptance. END

Thorium

Don H. Baker, Jr.

THE USE of thorium-magnesium alloys in missile and aircraft production has continued to cause slow upward trends in the domestic consumption of thorium. The atomic energy program for the utilization of thorium continues, with research and development of effective thermal breeder reactors showing progress. Many of the early disadvantages have been overcome by the application of the ever-increasing knowledge of engineering and design principles. At the end of the year it was impossible to forecast accurately the nuclear potential of thorium and its compounds; however, increased utilization is indicated.

In 1960, the Free World's mine production of thorium-bearing minerals was negligible. This was due to a concerted effort by the industry to reduce stockpiles and inventories of thorium-bearing materials. During the year, however, there was continued activity in exploration, development, and consolidation of mining properties in Idaho, Florida, and Montana by the Agency Creek Thorium & Rare Metals Corp.; Porter Brothers Corp.; Baumhoff-Marshall, Inc.; Sawyer Petroleum Co.; and National Lead Co.

Principal domestic refiners were Lindsay Chemical Division, West Chicago, Ill.; W. R. Grace Co., Davison Chemical Division, Baltimore, Md., Pompton Plains, N. J., and Erwin, Tenn.; and Vitro Chemical Co., Chattanooga, Tenn. Mallinckrodt Chemical Works, St. Louis, Mo., continued to recover some thorium from Idaho euxenite residues processed primarily for columbium and uranium. Some thorium was offered commercially by Davison Chemical Division, Erwin, Tenn.: Dominion Magnesium, Toronto, Canada; Sylvania-Corning Nuclear Corp., Bayside, N. Y.; Westinghouse Electric Corp., Lamp Division, Bloomfield, N. J.; Horizons, Inc., Cleveland, Ohio; National Research Corp., Cambridge, Mass.; Nuclear Materials and Equipment Corp., Apollo, Pa.; Vitro Corp. of America and Cerium Metals and Alloys Division, Newark, N. J. National Lead Co. of Ohio processed thorium metal for the AEC.

Thorium Prices

Compound: (100-lb lots)	Percent ThO_2	Price per lb
Carbonate	80-85	$6.25-8.00[1]
Chloride	50	7.00
Fluoride	80	5.50
Nitrate—(mantle-grade)	46	3.00
Oxide	97-99	5.50-8.50
Other forms:		
Metal—(Nuclear-grade)[2]	..	19.55
Thorium hardener—(for alloying)	20-40	12.50-15.00

Metal—(per lb)	Powder or pellets	Ingot
Less than 10 lb	$50	$54
10 to 100 lb	41	45
100 to 500 lb	34	38
500 to 2,000 lb	26	30
Over 2,000 lb	20	24

[1]Variable depending on rare-earth content.

[2]f.o.b. AEC, Feed Materials Production Center, Fernald, Ohio.

Reactor-grade (high-purity) thorium oxide was produced by Davison Chemical Division and by Lindsay Chemical Division. High-purity thorium oxide ceramic also was offered by National Beryllia Corp., Hackell, N.J.

Rio Tinto Dow, Ltd. in the Blind River area, Ontario, Canada, was recovering thorium compounds from the waste liquor of the uranium processing plant at Elliott Lake. The product from the 150-tpy plant was marketed in Canada, the U.S. and England. A new 150-tpy facility is being constructed at the Nordic Plant of Rio Algom Mines. Blind River uranium area contains the largest known reserve of thorium on the North American Continent. Thorium content of the developed uranium deposits in the area is one part thorium to two parts uranium and the reserves are estimated at over 200,000 tons of thorium oxide.

Free World reserves of thorium were estimated at over 1-million tons of ThO_2. The Ontario, Canada, uranium deposits and the beach and river placer sands of India and Brazil constitute a major portion of the reserve. Placer and vein deposits in the U.S., Union of South Africa, Australia, Madagascar and other countries provide the remainder.

Prices for domestic concentrates ranged from $1.75 to $2.25 per pound of ThO_2 content for 20 to 30% thorium concentrates. Price quotations for monazite per pound, c.i.f., U. S. ports were: Massive, 55% REO including thoria, 13c; sand, 55% REO including thoria, 10-15c; sand, 66%, 18c; and sand, 68%, 20c. (See table)

The major non-nuclear applications of thorium were in the form of magnesium-base thorium alloys used by the aircraft and missile industry. The characteristic of these alloys in retaining strength properties at elevated temperature, combined with light weight and stiffness, has led to their extensive use in the various missile and satellite programs. In fact, there are few if any missiles, either operational or in development, that do not incorporate one of the alloys in some form. The development of improved welding and fabricating techniques has enhanced the utilization of the magnesium-thorium alloys. Increased application will be possible with the development of brazing techniques and methods of plating other metals onto the alloy surfaces.

The consumption of thorium and its compounds in the gas mantle manufacture, electronic, refractory and chemical uses remained relatively constant.

The program for the utilization of thorium as a nuclear fuel was gaining impetus with the construction of reactors to test concepts and develop additional engineering data.

The fuel elements for the Advanced Epithermal Thorium Reactor under construction at Canoga Park, Calif., for Southwest Atomic Energy Associates were being fabricated by the W. R. Grace and Co., Davison Chemical Division, at its Erwin, Tenn., plant. This fabrication was the first such operation ever undertaken on a significant scale in private industry. A total of about 25 kilograms of U-233 will be utilized. The prime contractor for the AETR facility is the Atomics International Division of North American Aviation Corp.

The AEC announced plans to build a Molten Salt Reactor Experiment (MSRE) at the Oak Ridge National Laboratory, as a part of the Commission's effort to investigate advance reactor concepts which may have potential advantages for production of electrical power. The MSRE is designed as a 10,000 thermal kilowatt reactor, although routine operation

will be at about 5,000 kilowatts. No electrical power will be produced, as the heat will be dissipated to the atmosphere through a secondary heat exchanger. The molten salt fuel consists of a solution of fluorides of lithium-7, beryllium, uranium, zirconium and thorium. Construction is scheduled to be completed late in 1962 with operation planned for the spring of 1963.

Sodium cooled reactors are of interest in a wide range of neutron energy spectra from thermal, through intermediate, to fast. As a part of this broad program the Sodium Reactor Experiment was put back in operation late this year after the installation of a new core, consisting of thorium-uranium alloy. The test program is to provide information on the high temperature nuclear and physical characteristics of this material. The first Experimental Breeder Reactor, a fast reactor, continues to operate at the National Reactor Testing Station. Construction of the second Experimental Breeder Reactor is nearing completion, and start-up of this 16,500 KWE plant should take place early in 1961.

Increased demand is long overdue for thorium. With the reduction of inventories and stockpiles, mine production should increase in the forthcoming year.

Consumption of thorium in alloys should continue at a steady but increasing rate as research in new applications is continued.

Increased utilization of thorium and its compounds in the field of nuclear energy is further in the future—but definitely indicated with the information now being developed. Thorium offers the possibility of being the most economical fuel for breeder reactors. With thorium, breeder reactors can operate with no loss of fissionable materials and should operate with reduced power production costs. END

Selenium

Frank L. Fisher

THE INDUSTRY decreased in all departments in 1960 compared to 1959 when heavy buying in the last half of the year sent shipments to a near record high. Imports were below normal in 1960 and producers' stocks of marketable grades of selenium dropped an estimated 10%, reflecting a more stabilized supply-demand balance at year-end.

The 1960 production of selenium is estimated at 680,000 lb, down from the previous year's 800,000 lb, but slightly above the 1950-1955 average. Shipments by producers dropped sharply to an estimated 700,000 lb from the 1959 shipment of 1,011,000 lb. This sharp drop in shipments is attributed in part to the heavy purchases in 1959 by consumers to build up inventories as protection against a shortage, which could have resulted from the prolonged copper strike that was in effect during the last half of the year.

Commercial quality selenium was quoted at $7.00 a lb from February 1958 until July 1960, when the price was adjusted to $6.50 to $7.00 a lb to reflect more realistic market conditions. High-purity and ultra-high purity (99.999+% Se) selenium were quoted at $9.50 and $20.00 a lb, respectively. Ferroselenium was unchanged at $7.00 a lb, selenium content.

Imports for the first nine months totaled 119,121 lb. Of this quantity, 107,396 lb came from Canada, 9,503 lb from Belgium-Luxembourg, 2,200 from Japan, and 22 from West Germany. This does not include 13,448 lb of selenium-bearing concentrate imported from Rhodesia-Nyasaland. Stocks of selenium at producers dropped to an estimated 290,000 lb at year-end 1960. This is a four-year low and represents approximately five months' supply at the current rate of consumption. The stock figure is for marketable grades of selenium and does not include stocks at producers of slimes, residues, and other intermediate products. It is also subject to inventory changes and intraplant transfers.

Producing companies reporting selenium, shipments and stocks during the year were: Allied Chemical Corp., Marcus Hook, Pa.; American Metal Climax, Inc., Carteret, N. J.; American Smelting & Refining Co., Baltimore, Md.; International Smelting & Refining Co., Perth Amboy, N. J.; Kawecki Chemical Co., Boyertown, Pa., and Kennecott Copper Corp., Garfield, Utah. Allied Chemical Corp. and Kawecki Chemical Co. are manufacturing chemists. The bulk of the selenium produced in 1960 was by the other four companies as a by-product of the electrolytic refining of copper.

Increased selenium use in the electronic industry showed more promise in 1960 despite the sharp inroads into the selenium rectifier market by high-purity silicon and other semi-conductor materials. New electronic application of heavy metal selenides, especially those of silver, bismuth, cadmium, lead and zinc were under development in the thermoelectric and photoelectric fields. Heavy-metal selenide-tellurides and quaternary inter-metallics of selenium and tellurium also figured prominently in this widespread research.

Consumption of commercial and high-purity selenium were about equal in 1960 with a combined total of 93%. Use of ferroselenium accounted for most of the remainder. The use of selenium to improve machinability of 5% chrome steels and other steels was more widely adopted in 1960. Other uses of selenium in the chemical, metallurgical, rubber, pigment and glass industries had no marked change in their use patterns during 1960.

Selenium remained in Group I of the national stockpile List of Critical and Strategic Materials throughout the year. The OME included selenium among minerals eligible for Government financial participation up to 50% of approved costs and the element also was on the Department of Agriculture Barter Program during 1960. END

Beryllium

Donald E. Eilertsen

NEVER BEFORE was there so much beryl consumed in a single year in the U.S. as in 1960, and not since 1948 has the domestic production of hand-sorted beryl been so small. Almost all of the beryl consumption was processed by the Beryllium Corp. at Reading and Hazleton, Pa., and by Brush Beryllium Co. at Elmore, Ohio, into beryllium metal, alloys and compounds, mostly beryllium metal and beryllium-copper.

Both firms produced a substantial quantity of beryllium for AEC, and some for special applications in aircraft, missiles, space vehicles, and in research and development seeking new applications in these fields. The third year elapsed of the five-year contracts awarded Beryllium Corp. and Brush Beryllium by AEC for annual delivery of 37,500 lb of beryllium metal. As a constituent of alloys, beryllium was used to produce many high-strength hardenable copper-base alloys and contribute processing and final property improvements to light metal alloys. Beryllium oxide was uti-

lized in applications which required good thermal conductivity and high dielectric strength.

Colorado, Connecticut, Maine, New Hampshire, New Mexico, South Dakota and Wyoming together produced 210 tons of beryl and South Dakota's production was about 150 tons. Most of the domestic beryl production was sold at incentive prices to the Government through GSA on its purchase program for domestically produced beryl. GSA's depots for purchasing domestic beryl were located at Franklin, N. H., Spruce Pine, N. C. and Custer, S. D. Through November, GSA had purchased an approximate cumulative total of 2,685 short tons of hand-sorted beryl on this program, which began in 1952 and will terminate June 30, 1962 or when 4,500 tons of beryl is delivered, whichever occurs first.

Beryllium producers depended almost entirely on imported beryl for supplies. Hand-sorted beryl was imported from Brazil, Argentina, Portugal, India, British West Africa, Republic of the Congo (formerly Belgian Congo) and Ruanda-Urundi, French Somaliland, British East Africa, Mozambique, Malagasy Republic (formerly Madagascar), Union of South Africa, and Federation of Rhodesia and Nyasaland.

The Government, through OME, offered financial assistance until August to explore for domestic beryl, and thereafter for all types of domestic beryllium ores. OME participation in approved projects was 50% of the estimated exploration cost.

The U. S. Department of Agriculture through Commodity Credit Corp. (CCC) offered to barter surplus agricultural commodities with certain countries in exchange for strategic and other materials, which included beryl.

Scientists were eager to learn more about beryllium to make the metal more usable in supersonic aircraft, missiles, and in nuclear energy.

USBM continued its accelerated program on beryllium, consisting principally of closely examining domestic resources for beryllium deposits, developing milling methods to concentrate disseminated beryl and other beryllium minerals, and developing techniques to produce and purify beryllium. The search for beryllium in the field was greatly aided by using two fluorescence methods developed by the Bureau, which will detect as little as 0.01% beryllium in rock samples, by using a Bureau-developed mobile laboratory containing a spectroscope, and by using various nuclear electronic detection instruments. The Bureau also continued operating its experimental flotation plant in North Carolina, attempting to develop economical milling methods to recover 0.4% beryl from pegmatite deposits, which were estimated to contain more than 40,000 tons of beryllium metal.

In addition to the Bureau's work on beryllium, other research on the metal included studies on joining, purification, ductility, casting, rolling, and forming. In the beryllium alloys field, development work continued on beryllium-steel combinations, and additions of beryllium to molten aluminum for the aluminum cladding of steels.

Numerous searches for beryllium deposits were made in the U.S. and abroad by private individuals and concerns, and in some instances, studies on beryllium recovery were made.

The outlook for 1961 is for larger demand for beryllium products. END

Beryl Statistics
(Short tons)

	1960 estimated	1959
World production	9,000	7,300
U. S. mine shipments	210	328
U. S. imports	8,800	8,038
Total new supply	9,010	8,366
U. S. consumption	9,500	8,173
Average U. S. price per unit BeO (11% BeO)	$47	$47
Average foreign price per unit BeO (11% BeO)	$27	$27

Germanium

Frank L. Fisher

GERMANIUM CONTINUED to advance with the expanding electronic industry throughout 1960. Production, consumption, and imports increased over 1959. The number of germanium transistors produced continued to grow, while the production of diodes and rectifiers held their own despite sharp competition from high-purity silicon and other semi-conductor materials.

Technological advances were noted in all phases of germanium research and development during the year. The announcement of the so-called epitaxially-grown germanium crystals by vapor deposition was the highlight.

Domestic production of germanium from raw material is estimated at 54,000 lb for 1960, an increase of 20% over 1959. One new producer, American Metal Climax, at Carteret, N. J., came into operation to join the Eagle-Picher Co., Miami, Okla.; American Zinc Co., Fairmont, Ill., and Sylvania Electric Products Co., Towanda, Pa. The latter company expanded facilities during the year. Sylvania and American Metal Climax rely on purchased raw material primarily from foreign sources of supply and scrap, while Eagle Picher and American Zinc also have facilities to produce germanium as a by-product of their zinc operations. Each of these companies produces germanium dioxide in addition to several electronic grades of both polycrystalline and single crystal germanium.

Commercial-scale germanium originates as a by-product of base metal processing. The two major Free World producers in 1960 were the Tsumeb Corp. in South West Africa and Union Minière du Haut Katanga in the Congo. The only reported exploration for germanium from other than by-product sources during the year was in the Powell River area of British Columbia, Canada, by Taiga Mines Ltd. This operation was in the development stage in 1960.

The political and economic disturbances in Africa in 1960 have resulted in renewing investigations for the recovery of germanium from coal and other materials. USBM initiated research programs on the recovery of germanium from coal fly ash, development of a field test for germanium, and a reconnaissance investigation of occurrences of germanium and other semi-conductor materials in the Southwest. These research projects are centered at Rolla, Mo., and Bartlesville, Okla.

The prices for germanium, as quoted in E&MJ METAL AND MINERAL MARKETS, were unchanged during 1960. This firmness in price of germanium marks the first time in several years that the quoted price has not shown a gradual decline. The year-end price quotations in cents per gram are:
Germanium dioxide was 16.5¢ per gram in 1960 and single crystal germanium in 10,000 gram lots was 60.5¢ per gram and in 1,000 gram lots, 68.5¢ per gram.

Research made notable progress in 1960. In production, the recovery of germanium from the concentrate of the Prince Leopold Mine in the Congo was increased by magnetic upgrading and removal of high germanium values by means of a Franz Ferro Filter. The development of epitaxially-grown crystals in 1960 by vapor-growth techniques, utilizing an iodide dissociation process, is considered an important technological advance, be-

Germanium Prices

(Cents per gram, at year's end)

	f.o.b. shipping point	del.
1,000-gram lots:		
First red	30.15	29.5
Intrinsic	31.95	29.95
10,000-gram lots:		
First red	28.15	29.5
Intrinsic	29.95	29.95

cause it enables application of a simplified method for producing transistors which will have more accurate and predictable characteristics. This is a noteworthy example of the application of a known metallurgical process resulting in a technological breakthrough, enabling the solid state physicist to obtain material which conforms to more exacting specifications.

The Germanium Research Committee initiated research during the year on the synthesis and study of the properties of organic and inorganic compounds. This research is designed to develop non-electronic applications for germanium. The only non-electronic application in which a significant quantity of germanium is now used is as the oxide in mercury vapor lights, where the red luminescence of the oxide corrects the blue tint of the mercury vapor light. END

Cadmium

Harold J. Schroeder

THE DOMESTIC INDUSTRY in 1960 reported increased metal production and decreased consumption. A reduction in the quantity of imports and very large exports overbalanced the domestic factors of supply and demand and resulted in a rapid decline of available metal stocks.

Production of primary plus secondary cadmium metal was more than 10-million lb in 1960, an increase from the 8.6-million lb produced the previous year. However, general imports of the metal declined from 1.6- to an estimated 0.9-million lb. The total from both sources provided a new supply of 11-million lb, 10% greater than 1959. General imports of metal came from Canada, Belgium-Luxembourg and Peru. Imported flue dust used for production of metal came from Mexico and Canada and amounted to approximately 1.5-million lb of contained cadmium.

Apparent consumption of metal (computed by adding production, net imports, and net stock changes of producers, compound manufacturers, and distributors) declined 11% to 10.2-million lb. More than offsetting the decrease in domestic consumption was the strong worldwide demand for cadmium, which resulted in a threefold increase in exports to an estimated 2.7-million lb of cadmium metal and flue dust. Exports of cadmium metal, alloy, dross, flue dust, residues and scrap went to the United Kingdom, France, Japan, Western Germany, Netherlands, Italy and India.

Metal producers' shipments, including those for internal consumption, were 3.5-million lb in the first quarter. Shipments declined each successive quarter and the total was in excess of 12-million lb for the year. Stocks of cadmium metal, reflecting the high shipment rate compared to production, continued the rapid downward trend begun in 1959. Starting the year at almost 3.5-million lb, the stock inventory was reduced to 2-million lb by the end of September. A low of 1.5-million lb by year-end was indicated.

No barter contracts were made by Commodity Credit Corp. of surplus perishable goods for foreign-produced cadmium during the year and on Nov. 4 CCC announced that cadmium had been dropped from the barter list.

In September, GSA rejected all bids received on the advertised sale of 4,313 tons of 20% cadmium—80% magnesium alloy demilitarized bomb casings. The high bid of 11.35¢ a lb for the material was considered too low and new invitations to bid will be issued. One of the stipulations in the invitation to bid was that delivery of the material would be spread over a three-year period, amounting to a rate of about 600,000 lb of contained cadmium for each year.

Prices of cadmium metal for sticks, bars and shapes, in lots under one ton, increased from $1.40 to $1.50 per lb on Jan. 7 and an additional 10¢ to 1.60 on Sept. 28. The current worldwide strong demand for cadmium and the low level of stocks suggest a firm market for the months ahead. Cadmium metal production is in general not responsive to market changes since output is largely a by-product of zinc smelting.

Consumption of metal and compounds in electroplating continued to be the largest use for cadmium. Demand for chemicals and pigments was brisk and use in batteries required increasing amounts. A number of newer uses, such as control rods in nuclear reactors and heat and light stabilizers for plastics, used smaller quantities.

A cadmium sulphide transistor, believed to be the first of its kind, was announced by General Motors Research Laboratories. The cadmium sulphide was cited as being very sensitive to intensity and wave length of light, thus making it useful as a phototransistor. In research semi-conductors, Bell Telephone Laboratories revealed that cadmium sulphide is strongly piezoelectric and has a potential use in electromechanical transducers. Numerous companies were involved in development and research, utilizing the long-life dependability of nickel-cadmium storage batteries. There was a continuation of research and evaluation for the AEC on the relative merits of many materials, including cadmium, for use as atomic reactor control rods.

The outlook for 1961 is for a continuing high demand for the established uses of cadmium and in addition some growth in the newer uses. With production not expected to increase materially, and with stocks at low levels, a tight supply situation could develop. END

Rare Earths

Robert H. Lesemann

DESPITE the great potential of rare earths, very little of real importance has been discovered to develop any widespread acceptance of their uses. Few areas have been found where cheaper elements have not been able to serve adequately.

Cost is, therefore, a major hurdle blocking development, and 1960 saw prices virtually unchanged from 1959. However, the industry remains optimistic, and many sources feel prices will be reduced this year. This optimism is clearly reflected in expanded private and joint research programs.

One of the chief sources of rare earths has been as a by-product of thorium refining from monazite sands. When the Government stopped stockpiling thorium at the end of 1959, this cheap supply of raw material for private industry was cut off. But the Government is again negotiating for thorium and, although it is impossi-

Rare Earths

Oxide	1–4 lb	10–49 lb	50–99 lb
Thorium Nitrate, mantle grade	$5.40	$3.60	$3.30
Thorium Oxide, purified	11.25	7.50	6.88
purified	12.60	8.40	7.70
purified	10.37	6.90	6.33
Ceric Hydrate, coml	2.59	1.73	1.58
Cerous Oxalate, purified	4.50	3.00	2.75
Rare Earth Sodium Sulfate	0.32	0.22	0.20
Rare Earth Oxide	2.70	1.80	1.65
Rare Earth Chloride	0.54	0.36	0.33
Rare Earth Fluoride	2.13	1.42	1.30
Didymium Carbonate	1.53	1.02	0.95
Didymium Fluoride	2.14	1.43	1.31
Lanthanum Oxide	10.53	7.02	6.43
Neodymium Oxalate, 85%	2.52	1.68	1.54

High Purity Rate Earths And Yttrium Salts

	Grade percent	Per Gram 1-99 gm	Per Lb 1 Lb
Praseodymium Oxide	99.9	0.25	50.00
Samarium Oxide	80	0.15	30.00
Samarium Oxide	99.9	0.30	60.00
Europium Oxide	99	4.50	..
Europium Oxide	99.9	5.50	—
Gadolinium Oxide	80	0.20	45.00
Gadolinium Oxide	99.9	0.65	125.00
Samarium-Gadolinium Oxide	45	0.18	37.50
Terbium Oxide	99	2.00	850.00
Terbium Oxide	99.9	2.50	900.00
Yttrium Oxide	95	0.25	50.00
Yttrium Oxide	99.9	0.35	70.00
Yttrium Oxide	99.999	0.60	120.00
Yttrium Oxide	99.9999	1.50	300.00

ble to know if or when a contract will be reached, this is an encouraging sign.

A major research aim in the field is to develop volume use in a few industries rather than small quantity use in new areas. This would permit production on a larger scale, and consequent reduction in per unit costs.

The rare earth processors were well stocked when 1960 began, and they lived almost completely off inventories throughout the year. Consequently, domestic mine output fell sharply. Molybdenum Corp. of America's production of bastnaesite at Mountain Pass, Calif., was the sole source of ore in 1960. Some monazite was imported from Australia, but in general, last year's inventories proved to be more than sufficient Euxenite is the other major ore from which the rare earths are extracted. South Africa was the major supplier of ore (monazite) in 1959, but none of the orders were renewed in 1960.

As far as this year is concerned, most observers feel that existing inventories will be sufficient and that very little ore will be mined here or imported from abroad.

Consumption has varied very little in the past several years. Although final statistics have not yet been compiled for 1960, it seems safe to estimate in the neighborhood of 3500 tons of monazite ore.

Primary uses of the metals were also generally unchanged from 1959. They include flints, sparking metals, alloying agents in magnesium and aluminum, deoxidizer and scavenger additions to metals and ladle additives in cast iron and steel.

Oxides and compounds are used to decolorize glass, to make special optical glasses, optical polishing abrasives, refractories and as cores in arc-light carbons for searchlights. Other uses are in ceramic tiles, textile mildew-proofing, cosmetic powders and color television tubes.

Considerable interest exists in the work being performed by Nuclear Corp. of America on the use of gadolinium and celinite in thermoelectric generators. This, however, is still in the research stage and it is too early to judge its importance.

Vitro Chemical Co., currently producing a thorium-magnesium alloy, is gearing its research toward other rare earth master alloys of magnesium and aluminum. The master alloys will contain 20-40% rare earth elements with a final alloy content ranging from 2-4%.

Mischmetal, a combination of rare earth elements in metallic form, is similarly combinable with baser metals to produce finer alloys. They improve castability and fluidity of many metals and aid in the hot workability and forgeability of special grades of stainless steel.

The processors of rare earth concentrates and producers of separated metals and compounds are Davison Chemical Co., Div. of W. R. Grace & Co.; Electro Metallurgical Co.; Lindsay Chemical Div., American Potash and Chemical Corp.; Michigan Chemical Corp.; Molybdenum Corp. of America; Research Chemicals Inc.; St. Eloi Corp. and Vitro Chemical Co.

The principal producers of cerium and mischmetal and rare earth-bearing alloys and ferrocerium are American Metallurgical Products Co.; The Dow Chemical Co.; Electro Metallurgical Co.; Mallinckrodt Chemical Works; Ronson Metals Corp.; Castalloy, Inc.; General Cerium Corp. and Hills-McCanna.

Below is a current price list furnished by Lindsay Chemical Div.:

Metal	Grade percent	—Per Gram— 10-99 gm	100-450 gm
Lanthanum	99.9	$ .51	$ .34
Cerium	99.9	.50	.33
Praseodymium	99.9	.63	.42
Neodymium	99.9	.63	.42
Samarium	99.9	.66	.44
Europium	99.9	13.90	9.25
Gadolinium	99.9	1.10	.73
Terbium	99.9	5.63	3.75
Dysprosium	99.9	1.10	.73
Holmium	99.9	1.10	.73
Erbium	99.9	1.10	.73
Thulium	99.9	6.93	4.62
Ytterbium	99.9	1.89	1.26
Lutetium	99.9	12.87	8.58
Yttrium	99.9	.81	.54
Yttrium	80	.63	.42
Yttrium-Mg alloy	..	.36	.24
Thorium powder	..	.15	.10

END

Boron

Peter Colefax

PRODUCTION in 1960 will match 1959's record production of 860,000 short tons of primary borax, according to latest estimates by USBM. A strong fourth quarter, however, was needed to reach this level since domestic demand declined toward the end of the second quarter and remained at subnormal levels through the third quarter.

One market bright spot was foreign consumption, with increased demand reflecting the continued rise in living standards, which created a growing market for sanitary ware, appliances and other consumer items requiring boron products.

Textile fiberglass production is another area which offers special promise both at home and abroad and is expected to increase substantially the consumption of boron products. Domestic capacity in this segment of the fiberglass industry, for instance, was increased 50% during 1960.

While interest in boron-based high energy fuels and other upgraded uses of boron remains high, the industry's continued growth is solidly based on projected increases by the industry standbys: the glass, fiberglass and porcelain enamel producers. Other important non-exotic uses are in the manufacture of herbicides, soaps, fertilizers, antifreeze, electrolytic condensers, paper, leather, firefighting

compounds and boron in chemicals.

Principal methods of production—conventional mining employed by U.S. Borax at Boron, and chemical extraction employed by American Potash and Stauffer—remain unchanged, although American Potash has construction under way which will give it capacity for additional tonnages by means separate from any of its present processes. Production capacity from this source, together with additional tonnages the company expects to realize from its new evaporator plant, will up AP&CC's total borax production capacity at Trona by 35% by mid-1961. The increased capacity afforded by AP&CC's $11-million expansion includes all of the boron products presently produced and will provide additional tonnages of potash as well.

U.S. Borax, the largest of the three principal producers, improved its open pit operation at Boron with the installation of a continuous belt-lift that facilitates the rapid and efficient removal of large quantities of ore previously hauled from the pit by trucks. No major changes in Stauffer's primary production facilities were announced during the year.

Internationally, U.S. Borax's parent firm, Borax (Holdings) Limited, doubled the boric acid production of its French subsidiary plant at Couderkerque, near Dunkirk, and increased production substantially in England by expanding the Belvedere factory of Borax Consolidated Ltd. This company's Argentine subsidiary, Boroquimica Ltda., opened a processing plant at Campo Quijano, in the province of Salta, near the borate deposits of Puno de Atacama, an area reported to be rich in ulexite, which occurs in irregularly-shaped marshes and shallow pools that form the Salinas Grandes, a large dry lake situated more than 11,000 ft above sea level.

In December, American Potash announced formation of a new company, Seurobor (Société Européene du Bore), with the Société D'Electro-Chémie D'Electro Métallurgie et des Aciéries Electriques D'Ugine as an equal owner. Boric acid will be produced in a $2-million facility at Pierre Benite near Lyons, France, using ore from Turkish sources.

Stauffer's newly created International Division has also been active. It is producing boron compounds in Germany through Süddeutsche Chemische Werke, a wholly owned subsidiary, and Callery Chemical Co. announced a program under which it will exchange boron chemistry information with England's Imperial Chemical Industries.

Domestic exploratory activity was very limited. Several small companies drilled or scheduled exploratory projects for borax in Nevada and the Rocky Mountain states. Leprechaun Mining & Chemical, Inc. announced drilling operations for borates at Silver Peak, Nev., and an independent venture by Congdon-Carey will concentrate on borate exploration in the Rocky Mountain area. Foreign exploratory activity was principally confined to South America. In addition to Boroquimica Ltda.'s activity at Campo Quijano, Borax Argentina, S.A., which operates a 10,000 metric ton a year plant, indicated a further expansion of the Argentine borax industry when it announced it was seeking U.S. technical and monetary assistance to develop its deposits.

Primary producers of borax sustained their high level of research activity attained in 1959. Most of the U.S. Borax's estimated $2-million research budget and over 50% of American Potash's $2.5-million projected research budget was earmarked for boron research. It is not known what percentage of Stauffer's research budget—estimated to be $3-million for the first half of 1960—is devoted to boron research. In addition, secondary producers, independent research organizations, and government and university laboratories are increasing boron research.

AFN, Inc., jointly owned by American Potash (50%), National Distillers & Chemical Corp. (25%), and Food Machinery & Chemical Corp. (25), and Aerojet-Stauffer continued process development on high energy borane fuels. No longer being considered as fuels for manned aircraft, the strategic importance of these products is related to their potential use as storable fuels in ballistic missiles.

New product emphasis during the year was essentially the same as 1959.

Those receiving special attention include the borophanes (boron phosphorous compounds), boron nitrogen materials, elemental boron, boron trichloride, boron tribromide, boron alkyls, metallic borides and boron trifluoride.

American Potash's interest in the metallic borides was announced in an agreement to develop applications for titanium diboride in the aluminum industry with Firth Stirling, Inc., of Pittsburgh. Development work on the joint program is being done by Borolite Corp., a wholly-owned Firth Stirling subsidiary. AP&CC holds an option to purchase a controlling interest in Borolite.

Titanium diboride and its alloys have good corrosion-resistant properties and possess favorable electrical characteristics which offer significant economic advantages, particularly as cathodes in aluminum reduction lines. American Potash also prepared and distributed market development quantities of lanthanum and other rare earth hexaborides to interested potential users.

U.S. Borax has announced a boron-plastic compound for use as a building insulator and Stauffer revealed work on boron-containing plastics and synthetic rubber. END

Titanium

D. P. Eigo

IN ITS RECOVERY from the 1958 nosedive in demand, the titanium industry began a series of moves toward new growth: 1) a reduction in production and capacity to better match the reduced demand which followed the Government's cutback in military aircraft spending; 2) a steady effort to lower the price of titanium metal to help it compete with other light weight, strong, "space age" materials; 3) development of new (and preferably non-military) uses; and 4) a divorcement from reliance upon defense spending.

Metal production, which was at 17,249 tons of sponge metal in 1957 for all of the Free World, dropped to 4585 the following year, to 3898 in 1959 and rose to 4500 in 1960. Consumption last year was 4600. Several firms abandoned the titanium business in the difficult years following 1958 and contributed to the return of production to near the consumption level.

The second move has been spectacularly successful. The price of commercially pure sheet-strip-alloy bar-ingot (a combination which composes Titanium Metals Corporation of America's price indicator) went to $6.97 per lb. In 1957, the figure was $11.97 per lb.

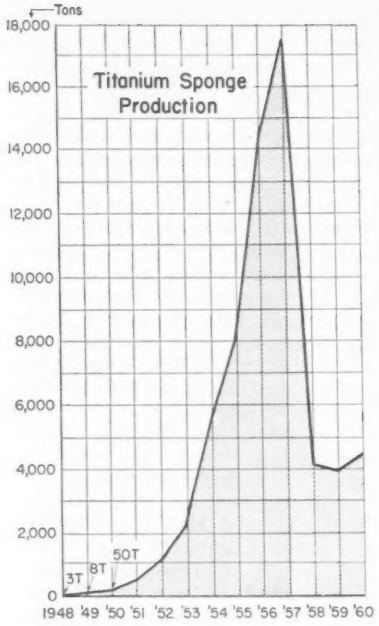
That drop, according to TMCA's T. W. Lippert, made titanium "one of the least expensive materials designed into (General Electric Co.'s) current family of jet engines." In fact, says Lippert, one of the most important factors in titanium's new showing is "the stiffening price competition titanium is providing the more established engineering metals."

In the third area, titanium has found increasing use in new alloys, in welding titanium to steel (to permit use of thin-gage titanium for lining

vessels, tanks and ductwork) in forgings, and in the chemical industry. The latter area consumed 2% of the non-military market and, according to Lippert, "two chemical plants replaced conventional equipment with 45 titanium heating exchangers because of titanium's price."

The other 13% of the non-military part of titanium's consumption went into commercial aircraft construction.

The fourth move by the industry, less dependence upon the military, has found the military becoming more attentive. In 1960, the Army specified titanium for the portable "Davy Crockett" recoil-less rifle, the Defense Department specified the metal for liquid and solid-fueled rocket applications, and the Air Force bought more planes and engines which contained more titanium. Some 17% of Ti's shipments were scheduled for use in missiles, according to TMCA, against 15% in 1959.



Ti is actually better off than it looks. The traditional indicator of the metal's position is sponge production (see chart). But that was the military period of titanium's early history. Today, the industry prefers to point to mill product shipments as a more accurate guide. And in that frame, the picture is much brighter. Mill product shipments in 1960, for instance, totaled 10-million lb, only 1.3-million lb under the best year—1957, when the military was playing fairy godmother.

Once again, the lower price and accompanying increased acceptance were the major factors. Sponge metal, incidentally, stayed at $1.60 per lb through the year.

Research and development by industry and Government continued throughout the past year, principally devoted to expanding applications for existing alloy grades mentioned above. But two new alloys came into use in 1960—one for use in jet engines, which raises titanium's useful temperature resistance to 1000 F, according to TMCA, and the other for use in the processing industry. The industry also improved production techniques in the areas of high strength and available size ranges, and developed welded titanium tubing to a point where it has obviated the need for the more expensive extruded titanium in many chemical applications.

In other areas, Wyman-Gordon Corp. is forging all-beta titanium, and the new Astrology alloy for 1500 to 1800°F applications. Titanium spheres for rocket fuels continued to improve in usage, and the Atlas, Titan, and Polaris missiles are using titanium for fuel, pressure control and similar devices in flight, according to Electrada Corp.'s Airite Division, which has a $3-million contract from the Government.

William H. Feathers, president of Union Carbide Metals, in a year-end announcement discerned "slow but steady progress" in the aircraft industry and suggested that the metal might soon attain "increased acceptance in submarine building."

The latter reference concerns a study project by the Bureau of Ships, U.S. Navy, devoted to the possible use of titanium-hulled submarines for deep diving operations. The strength-weight ratio which makes the metal so attractive in high-flying manned aircraft is apparently equally interesting when man wants to travel safely into the pressured depths.

Other research includes the development of titanium diboride applications in the aluminum industry by Firth Stirling's new Borolite Corp. Titanium diboride and its alloys have good corrosion resistance and possess favorable characteristics for possible use as cathodes in aluminum reduction lines. Firth Stirling shares interest in the project with American Potash & Chemical Corp., which holds an option to purchase a controlling interest in Borolite.

Frank W. Stamper, commodity specialist for USBM, estimates Free World production of titanium metal for 1960 and 1959 as follows: (short tons)

	1960	1959
England	**1300**	1300
Japan	**2600**	2730
U. S.	**4500**	3898

About 2200 tons of titanium sponge metal was imported from Japan during the first nine months of 1960, says Stamper, with 390 tons in the dutiable category and the remainder brought in free for the Government.

The future, as one California politician observed, lies ahead. Titanium looks forward in 1961 and '62 to continued effort in price reduction, continued success in non-military expansion of its market, and wider application in aircraft and chemicals.

In the military sphere, the "Davy Crockett" is expected to consume 2-million lb of titanium in the next five years, principally because inclusion of Ti in its design has cut its carrying weight by 80 lb. In military aircraft, the J-57 jet engine (for the B-52) and the J-93 (the B-70) both use titanium extensively. The on-again off-again B-70, long a favorite project of titanium producers, is on again, with a Pentagon policy shift in October 1960 in support of rapid expansion and development of the high-speed (2000 mph) high altitude (70,000 ft) bomber. Besides its engine, the B-70 is also a titanium consumer in wing forgings, the forward cabin section and empennage. END

Mercury

J. R. O'Connell Jr.

THE MERCURY MARKET rippled once in February, gasped in April and rolled over into a semi-conscious stupor in mid-July. Prices began the year at $211 per flask, moved as high as $214 in March and dipped to $209 to stay in July. The 1960 E&MJ average was $210.760, down from $227.484 in 1959.

Mercury, as did most metals, suffered from the depressed state of the U.S. economy in 1960. When spring arrived and demand failed to increase, prices never took the predicted upturn typical of past seasons.

The year 1960 saw U.S. output nearly pinpoint that of the previous year, consumption drop about 15% and imports decline 30%. Consumption moves with the expansion of chlorine and caustic soda producing facilities and new starts. With capital expenditures down, mercury can be expected to continue to sell at lower than normal prices. Experts are looking for the market to remain steady in

1961 at approximately the price position it finished the year.

Despite a lack of enthusiasm for 1961 prospects, informants agree that the market has not moved too far away from its normal state. The consistent low price in 1960 has kept and will continue to keep marginal U.S. producers out of the market. Better prices in Europe—at least better than in the U.S.—keep the amount of foreign material on the open market at a minimum. In 1960 most metal arriving here was delivered on a contract basis—much of it to satisfy individual company replacement of mercury cells. London was about £70 ($196½) at mid-year; £69 ($193½) at the end. While at present there is little demand for mercury, the market is not glutted. It would firm with any real economic improvement.

For review purposes and for the sake of the uninitiated, a quick look at the procedures in the pricing and marketing of mercury will be taken. A great many transactions—both buying and selling—are based on the E&MJ weekly quotation. This appraisal for prime virgin domestic and imported metal is the New York price for large lots (20 or more flasks of 76 lb). In the case of foreign metal, the price includes a $19 per flask duty. Exporters to the U.S., of which Spain, Italy, Mexico and Yugoslavia are the major factors, get the N.Y. price less tariff and costs of freight and insurance. In comparing end-of-year prices, one finds that exporting countries were realizing only about $185-87 per flask, while the market in Europe was $6-8 higher. As a result, foreign producers have been less anxious to bring metal here and have been concentrating efforts in the more profitable European and Far Eastern markets. Such was the case throughout most of 1960.

Foreign producers also keep an eye on the level of business activity of the U.S. industry. They are reluctant to pressure the domestic industry by placing idle stocks on the open market. They believe that the tariff is high enough.

Traditionally, the U.S. industry has been dependent on imports to supplement domestic output. Endowed with richer ore and the beneficiaries of lower labor costs, foreign producers are limited in their ability to corner the market here by the tariff and constant threat of its upward revision.

U.S. producing mines are centered in California, Nevada and Idaho, with Alaska next in importance. Average industry ore runs about 3¼ lb of mercury per ton in California, but has been known to run as high as 25 lb. At 3¼ lb the industry is marginal, producers say.

Mercury Statistics

(Flasks—76 lb)

	1960 (b)	1959
Mine production	31,500	31,256
Secondary	5 000	4,950
Total	36,500	36,206
Stocks end:		
Producers	1,750	1,880
Consumers, dealers	13,000	11,700
Total	14,750	13,580
General imports	18,500	30,260
Exports	400	640
Consumption	47,000	54,895
Price (a)	$210.760	$227.484

(a) Final. (b) U.S. Bureau of Mines figures for 1959 and estimates based on USBM third quarter 1960 data.

Oddly enough prices are determined in New York City rather than the West Coast. Most of the large industrial consumers of mercury are in the East as are agents for imported metal. Because of the small size of the producing unit, marketing organizations are limited. Most of the mines in the past have sold directly to dealers or operated through sales agents—many of whom are located in New York City. One West Coast producer complained recently to E&MJ's correspondent: "We're in a helpless condition on price. We produce mercury here in the West, but the price is determined in the East." Others, the writer said, claimed prices should be determined by producers rather than buyers and brokers.

It should be explained here that this notion is faulty. Large refiners of mercury in the East are usually also dealers in flask mercury. They very often price their refined products on the basis of the E&MJ quotation. They are definitely not interested in seeing prices moving downward. Independent dealers naturally are interested in buying as low as they can negotiate—often well below the E&MJ average. They will in turn sell as high as possible—only rarely, however, do they get a premium above the E&MJ. An agent on commission likewise will attempt to get the best price possible; but to move metal in a slow market he must be realistic. As a dealer here put it, "Some days we are buying and would like to see a low quote; others we are selling and would like to see it higher. We give and take. It is to our advantage to have a price appraisal that reflects the true market." The above comment may shed some light on why New York is the mercury pricing center. There may be some case for an f.o.b. mine quotation.

Depressed markets foster changes in marketing procedures. The consumer seeks to avoid the middleman; the producer seeks a certain outlet for his product. Freight rates take on added importance. (They range from $5-$10 per flask.) Thus an early-1961 report from the West Coast that mercury was sold to a broker for $196.50 has provided further evidence to those observers who believe that, were prices quoted West Coast, freight extra, the delivered cost to consumers would run slightly lower. This kind of thinking resulted in some changes in purchasing practice in 1960. Many consumers have contracted directly with mines for a regular monthly shipment. Intermediates have handled a lesser share of the market. It has been estimated that about 90% of the buying done by the limited number of large industrial consumers is on long-term contract.

The domestic industry feels it is caught in a price squeeze. Its situation is comparable to that of lead and zinc. Prices are at a 1953 level at 1961 labor costs. Now there is no U.S. purchase program to sop up surpluses. A recession for mercury miners in reality began late in 1959.

The market echoed with rumors of barter deals throughout the year. It was therefore a distinct shock when mercury was dropped from the barter list late in the year. Some believe it will be back on in 1961, if there is no sign of economic recovery.

War and gold are the only possibilities for a mercury surge in 1961, one forecaster ventured. War with shortages and shipping difficulties is unpleasantly self explanatory. A devalued dollar, he suggested, would be an unacceptable exchange for Spanish, and Italian metal. He pooh-poohed rumors of upped requirements for missile production. "Maybe a few extra pounds a year," he said.

Two large reduction plants will go onstream in 1961—one in Spain, the other in Yugoslavia. The latter will be in service at the Idrija Mine and will have a capacity of 250 metric tpd. It will feature the largest single mercury furnace ever built. A similar but smaller plant is being built at la Esperanza Mine near Mieres in northern Spain for Astur-Belga de Minas S.A., with a capacity of 150 metric tpd.

European sellers should continue to resist dealing at depressed U.S. prices as long as Continental demand holds up. They see prices here as unreasonably low.

Look for prices in 1961 to be steady on or around the current level of $209. A flutter upward in the second half is possible. END

Non-Metallics

J. C. Carrington
Vice President
Freeport Sulphur Co.

Sulphur reached new heights in consumption and production in 1960; expansion in other than elemental production took place in many foreign areas. p 116

Finn B. Domaas
Assistant Editor
Engineering & Mining Journal

Wet-process phosphoric acid will increase demand for phosphate. Recent improvements help trim concentration costs. Steady U.S. stand helps raise phosphate export prices. p 114

Colin McAneny
Assistant Editor
Engineering & Mining Journal

New data on Soviet asbestos industry show USSR fast closing Canada's margin as world's No. 1 source. New domestic market may open—mixing fibre with asphalt for highway surfacing. p 119

Taber de Polo
Commodity Specialist
U.S. Bureau of Mines

Feldspar met continuing substitute-competition, keeping prices depressed. However, increased demand in new construction uses kept U.S. output close to 1959 levels. p 112

Reginald Rowand
Production Manager, Baroid Division
National Lead Co.

Barite, with an estimated 276,000 tons of production in 1960, is still far from the 1.3-million high of 1956. Major causes are reduced domestic oil exploration and improved foreign competition. p 118

L. E. Read
General Manager
International Salt Co.

U.S. rock salt production has increased in the face of Canadian competition. New mining and treatment methods were developed. p 113

William S. Steele
President
American Vermiculite Corp.

Vermiculite output in 1960 roughly equals 1959. Use as wallboard coating, lube-oil ingredient, and food additive foretell possible increased demand in 1961. p 111

Milford L. Skow
Commodity Specialist
U.S. Bureau of Mines

Mica retained 1959 demand levels in electronic and electrical applications. Ground mica sales and block and film imports fell sharply. Research on synthetic sheet mica continues. p 112

R. B. McDougal
Commodity Specialist
U.S. Bureau of Mines

U.S. fluorspar production increased substantially in 1960 to meet vigorous demand. p 114
Gypsum producers experienced a slow year. p 111

Nelson C. White
Vice President
International Minerals & Chemical Corp.

Potash production and deliveries came into balance after a two-year period of production curtailment to reduce inventories. Substantial additions to North American capacity will arrive in the next two to three years. p 117

Gypsum

Robert B. McDougal

INDUSTRY ACTIVITY in 1960 was lower than during the previous year, largely the result of the lower residential construction rate.

Expenditures for new construction in the U.S., which amounted to $45.2-billion in the first 10 months of 1960, comprised of private ($31.8-billion) and public ($13.4-billion), were about 1% below the similar period in 1959. Practically all types of private construction put in place exceeded the 10-month total in 1959, except new residential dwelling units which decreased 15% and accounted for an over-all decline of 2% in private construction. A 29% drop in residential buildings put in place resulted in an over-all 3% decrease in the public construction category. New private and public dwelling units begun between January and September 1960 totaled 1-million, down 9% from the same period in 1959. The average seasonally adjusted rate was 1,356,000 units. Average construction costs for 1-family houses started during the first 8 months of 1960 were $13,587, over 2% greater than the $13,278 reported for the corresponding 8-month period in 1959.

U.S. crude gypsum production in 1960 was about 10% below the previous year, when a record 10.9-million short tons were produced. Nearly 9.2-million tons of calcined gypsum were produced, slightly less than in 1959.

Imports of crude gypsum in 1960 were expected to reach 5.3-million tons, a decrease of almost 12% from the previous 12-month period. Canadian producers supplied 3.9-million tons or 75%. Crude gypsum exports from other countries to the U.S. were: Mexico, 564,000 short tons or 11%; Dominican Republic, 564,000 or 10%; Jamaica, 224,000 tons or 4%; and 37 tons from the United Kingdom. The 1960 imports were expected to account for 35% of the apparent crude supply.

New mines and plants were put into operation or under construction in 1960. National Gypsum Co. began construction before midyear of a fully automated products plant at Port Tampa, Fla. Gypsum wallboard, lath, sheating, and plasters will be manufactured there for the growing Florida market, which was formerly supplied by the company's plant at Savannah, Ga. Raw material will be shipped from company deposits in Nova Scotia. A $25-million expansion program in the Great Lakes area was completed when National Gypsum Co. placed its new Lorain, Ohio, plant into operation in March. The plant will manufacture gypsum wallboard, lath, and plaster. Acquisitions of Union Gypsum Co., Phoenix, Ariz. by National Gypsum Co., provided the latter firm with a West Coast market area.

New Mexico became the 22nd state to report gypsum production when American Gypsum Co. opened a new board plan at Albuquerque. Kaiser Gypsum Co. also started early in the year a multi-million dollar products plant at Rosario, south of Santa Fe, N.M.

Big Horn Gypsum Co. began construction in May on a $3-million board plant at Cody, Wyo. An open-pit mine 4.5 miles south of Cody will be the source of raw material for the plant, which is to have a capacity of 100-million board feet of gypsum annually.

Bestwall Gypsum Co. was to have begun construction in September on a $7.5-million building-products plant at the Marine Terminal, Wilmington, Del. The plant, to be completed late in 1961, will have a productive capacity of 150-million board feet of gypsum lath, sheathing and wallboard, annually. In addition, wall plasters, graded commercial rock and agricultural gypsum will be marketed.

The Barrett Division of Allied Chemical Corp. will make gypsum wallboard from gypsum, chemically produced as a by-product from the manufacture of wet-process phosphoric acid. Barrett developed a purification process, which permits the use of by-product gypsum. An equivalent of 85,000 tons of crude ore will be used annually in the new plant at Claymont, Del.

Further expansion in the gypsum industry is anticipated in 1961. United States Gypsum Co. took options to purchase a plant site at Baltimore for a gypsum products plant, the company's seventh on the eastern seaboard. Crude gypsum from company deposits in Nova Scotia will supply the plant, which will serve the Baltimore-Washington market area. Construction is to start early in 1961, with completion set for early 1962.

Kaiser Gypsum Co. exercised its option to purchase a site in Jacksonville, Fla., for a multi-million-dollar gypsum products plant. END

Vermiculite

William S. Steele

THE TONNAGE of vermiculite during the year 1960 was approximately equal to the previous year's tonnage, but net earnings decreased in some areas, while in other locations earnings were equal or ahead of net profits for 1959. Greater earnings in such territories developed from increased plant capacities and the impact of new uses for vermiculite which have been developing during the past two or three years.

Lower earnings followed the general construction pattern of crippling strikes and unfavorable weather conditions over extended periods in various sections of the country.

South African vermiculite ore imports for 1960 were virtually equal in tonnage to 1959 figures, although an increase of 20% had been predicted.

The definite trend in home construction, substituting dry-wall sheets and board in place of conventional lath and plaster, has led to the development of coating materials which are used over such bases to simulate acoustical or textural finishes, both plain and in color. The use of these premixed, vermiculite-aggregated coatings provides warm, joint-free surfaces which offer equivalent or improved decorative wall and ceiling surfaces, at little extra cost. Tuf-tex, produced by Lahabralite Company, Anaheim, Calif., is an outstanding example of these finishes.

Substantial progress has been made in the field of special oils and greases containing pulverized, exfoliated vermiculite for cooling and lubricating operations at high temperatures. Research is also being conducted with grit-free vermiculite as an additive in both human and animal foods.

A project programmed to get under way in Florida early in 1961 has real possibilities as an aid to retired and partially incapacitated people. Individual vermiculaponic beds will be provided by a central organization, which will furnish instructors and a central sales organization to the participants in the association. The individuals will be trained in the growing of fruits, vegetables and flowers in vermiculite beds. They will be supplied with seeds, chemicals and other necessities, and the organization, which will market the crops, will pay them a percentage of the profits from the sales of their own products. The emphasis will be on fruits grown out of

season, for northern markets. A centrally located commercial hydroponic operation will form the nucleus of the program, developed under the guidance of Dr. Maxwell Bentley of Johannesburg.

The development of vermiculite concrete blocks, slabs, plank and other forms has progressed rapidly, aided by research with aerating and foaming additives, as well as other formulae incorporating latex in the mix.

Successful fire tests at Underwriters' Laboratories and physical tests under ASTM auspices during the past several years have resulted in the generic acceptance of vermiculite, regardless of the source of the ore. Both authorities now accept vermiculite plaster aggregate weighing from 6 to 10 lb c.f. The former minimum weight was 7-½ lb c.f.

Verlite Co., Tampa, Fla., opened its modern new vermiculite exfoliating plant, utilizing South African vermiculite, in October 1960. The Zonolite Co. established a new branch exfoliating plant at Lubbock, Tex., operating with Montana crude ore, at about the same time. Several independent plants, now in the planning stage, are expected to become active in the course of the coming year and on into 1962.

Increased research budgets for 1961, allocated by both the Vermiculite Association, Inc. and the Vermiculite Institute, are expected to successfully conclude several projects now in operation and proceed with other activities now in the planning stage.

Tonnage for the year 1961 is expected to increase somewhat over 1960, but it would be overly optimistic to predict a volume in excess of 225,000 tons at this time. END

Feldspar

Taber de Polo

PRODUCTION DROPPED a little below the 1959 figure of 548,435 long tons. Demand for pottery and flat glass lagged. Requirements for production of glass containers increased. Increased demand in new construction uses such as glass curtain walls, cellular glass, and replacement of windows by glass block aided the industry.

Continued competition from substitutes and excess production capacity kept the selling price of ground feldspar at a depressed state.

The smaller companies met stiff competition and had a hard time marketing their product. Golding-Keene Co., one of the older producers, went out of business during the year and sold all its assets in New Hampshire and Trenton, N. J. Feldspar Corp., which produces a third of the nation's feldspar, completed a new modern flotation plant in Middletown, Conn., raising the number of plants the company operates to five. This plant will commence operation early in 1961 and will produce glass and pottery grade feldspar, and mica and silica as by-products. This plant will further increase the percentage of feldspar produced by flotation, a continuous upward trend for the past 15 years.

Imports of crude feldspar were negligible. Spar Mica Ltd., a U.S.-controlled company in Canada, ceased operations early in the year. Imports from Canada of nepheline syenite, the principal substitute for feldspar, continued at almost the same high level as in 1959 when 184,464 short tons were imported. There is no tariff on nepheline syenite coming into the U.S. U.S. feldspar producers have appealed a finding of the Tariff Commission in August that nepheline syenite was not being dumped at unfair prices.

Production of aplite, for use in making amber glass and window glass, decreased about 5% in 1960 from 1959. All aplite production was from Virginia. END

Mica

Milford L. Skow

DEMAND for sheet mica in 1960, essentially unchanged from 1959, was sustained by the continued high level of production of electronic and electrical equipment. The electronic industry used about 65% of the block and film mica fabricated in the U.S. Electrical insulation required about the same over-all quantity of splittings as in 1959, chiefly for molding plate and segment plate. Reconstituted mica, the paper-like material made by delaminating and reconstituting natural mica scrap, again was used principally in applications formerly requiring insulation made from splittings and also as the dielectric in certain capacitors. A slight increase in production of reconstituted mica strengthened the substantial gains which were accomplished in 1959.

Mica Statistics

(Thousands of pound)

	1960 estimate	1959
Imports:		
Block:		
India	950	2,200
Brazil	1,390	1,650
Other	40	160
Total	2,380	4,010
Film:		
India	99	274
Other	1	1
Total	100	275
Splittings:		
Muscovite	7,290	6,145
Phlogopite	520	658
Total	7,810	6,803
Consumption:		
Muscovite block and film:		
Good Stained or better	90	91
Stained	1,400	1,402
Lower than Stained	1,400	1,364
Total	2,890	2,857
Splittings:		
Muscovite	6,500	6,726
Phlogopite	460	497
Total	6,960	7,223

Sales of ground mica were estimated about 10% below the 1959 volume of 106,000 short tons. The drop was due largely to the smaller demand for paint and asphalt roofing because of decreased activity in the building industry. Dry grinding produced about 85% of the total tonnage and wet grinding the other 15%.

The sharp drop in imports of block and film mica resulted partly from increased imports of fully manufactured mica parts, particularly capacitor films, and partly from decreased Government purchases for the stockpile. All contracts under the Defense Production Act program for procurement of mica from foreign sources were terminated by June 30. However, some block and film mica continued to be acquired by the Government from a number of the importers who accepted the offer to convert unfulfilled portions of these agreements to barter contracts. Other barter contracts were in effect for splittings and resulted in increased imports of muscovite splittings. Although Brazil greatly increased its portion of the total block mica imported into the U.S., and actually supplied more than 60% of this category, India continued to furnish most of the total muscovite sheet mica and the Malagasy Republic (Madagascar) virtually all of the phlogopite.

Production of muscovite block, film, and hand-cobbed mica under

the Government domestic mica purchase program was down appreciably from 1959 but still was at a fairly high level. More mica was being sold in the hand-cobbed state for processing by the Government contractor. Continuation of the 1960 rate of production will not result in filling the program quota—25,000 short tons of hand-cobbed mica or its equivalent in trimmed mica—before the expiration date, June 30, 1962. By the end of 1960 an estimated 21,600 short tons had been accepted toward the quota.

Synthetic mica again was produced by Electronic Mechanics, Inc., Clifton, N. J., and Synthetic Mica Division, Mycalex Corp. of America, W. Caldwell, N. J. Because present methods produce principally flake material, synthetic mica is not yet a substitute for strategic grades and qualities of natural mica. However, a limited quantity of high-quality sheet material was recovered and fabricated into spacers for a special type of electronic tube and components for instruments and other exacting applications. The bulk of the synthetic mica continued to be used in various glass-bonded mica ceramics, materials that fill a number of critical needs in modern technology.

After February, only two contracts remained in the industry-Government program for development and evaluation of substitutes for strategic natural mica. General Telephone & Electronics Laboratories, Inc. (contract originally with Sylvania Electric Products Corp.), Flushing, N. Y., and the U.S. Bureau of Mines, Norris, Tenn., continued research on development of reconstituted synthetic mica sheet suitable for electronic applications. Accomplishments of the program include a practical method of producing from commercial flake synthetic mica, a reconstituted mica paper showing promise as a capacitor dielectric, information on improving the properties of this reconstituted sheet by heat, pressure, and bonding agents, and laboratory development of a strong, flexible, synthetic-mica film having high dielectric strength and resistance to thermal decomposition. Present activity is focused chiefly on further development of this material.

END

Rock Salt

L. E. Read

U.S. PRODUCTION of rock salt reached a record high of 6,160,000 tons in 1959 compared to 5,407,000 tons in 1958. This domestic production increase is considerable in view of the recent completion of three new rock salt mines in Canada, whose products have to some extent invaded the U.S. market.

Two new mines which will add to domestic production are the Morton Salt Co.'s mine at Fairport Harbor, Ohio, which went into production in December 1959, and the Cleveland mine of the International Salt Company, which is expected to be in production in 1961.

The older existing operations for the most part are located in Kansas, Louisiana, Texas, Michigan and New York, where room and pillar mining is conducted in flat bedded deposits at depths up to 1200 ft. The more recent installations in Ohio have gone to depths of 1750 to 2000 ft. These newer mines have been located on deep water where the bulk product can be transported by lake vessels to take advantage of lower transportation costs. Producers in Louisiana are barging salt up the Mississippi River and its tributaries.

Water transportation has created a change in the method of distribution of rock salt through the establishment of docks and warehouses around the Great Lakes and at principal points on the Mississippi and Ohio River systems.

Mines have been modernized to improve efficiency and production.

For instance, Universal Cutting machines are replacing shortwall cutters; ammonium nitrate prills have replaced dynamite in all but a few operations with good results and savings in costs; the use of diesel equipment is increasing in underground operations; Gradall equipment is being used for mechanical roof scaling in some mines and has shown savings in labor; a continuous boring miner is being tried out in one of the mines with some success.

Also, car and track haulage systems are giving way to conveyor belts, trucks, shuttle cars or a combination of these various components for improved haulage; the newer mines are being equipped with friction type Koepe hoists, wire rope guides and bottom dump skips; hoist equipment in production and service shafts are being automated to reduce labor costs.

Bedded rock salt deposits contain bands of dolomitic anhydrite which tends to reduce the quality of the finished product, unless removed during processing.

The most successful method of beneficiation has been by use of equipment developed and patented by the International Salt Co. and now in operation in their Detroit mine. This separator operates on the diathermacy of rock salt and employs its ability to transmit radiant heat.

Using this principle and subjecting the product to infrared lamps, the impurities, absorbing more heat than the rock salt, cling more tenaciously to a heat-sensitive resinous covering on a belt conveyor, and separation is made by the difference in trajectory.

At the Fairport Harbor mine, the Morton Salt Co. has used an impactor type crusher to separate the rock salt from the anhydrite. Separation is based on the difference in the hardness and elasticity of the two materials.

Four grades or sizes of rock salt are produced ranging down from ½ in. Since rock salt degrades in handling, and the demand is for the coarser grades, all producers have somewhat the same problem in overproduction of fines of minus 10 mesh, for which the market is limited.

This problem is being approached from several angles, such as compacting the fines to a coarser product by flaking mills and by fine screen separation of the fines to recover the coarser fraction which will be marketable. The primary difficulty in marketing fines is their tendency to set up and harden.

Since the greatest demand extends over a short period during the winter months for ice control, most producers have trouble in trying to balance production against demand.

This situation has caused some producers to consider underground facilities for preparation and storage of the finished product. As the grades are separated, they are diverted to separate storage areas in the mine. This provides for the hoisting and shipping of each grade according to the demand on any particular day. This program makes it possible to continue mining, preparation and storage throughout the summer regardless of the reduced demand, and not only makes for more uniform employment throughout the year, but retains in underground storage sizeable quantities of finished grades to supplement the regular production during the winter months.

Interestingly enough, salt mines, due to their considerable depth, uniform temperature and humidity, structure and character of formation, are being surveyed and studied for use as

storage areas for products which are commonplace as well as some which provoke much thought and imagination.

The Hutchinson, Kan., mines of Carey Salt Co. has an elaborate storage center for vital records, while their Lyons, Kan., mine has experimental chicken and stock raising facilities underground. AEC has conducted tests at Carey's Hutchinson mine, which would indicate that radioactive wastes can be stored in rock salt formations. AEC has also conducted experiments at Carey's Winnfield, La., mine to test out the "Decoupling" theory to prove whether or not clandestine underground nuclear explosions can be conducted without detection at any great distance from the source (described at the October Colorado blasting symposium).

From all this, it would seem that excavations made by mining in rock salt formations may some day come into use for varied purposes; therefore, some thought should be given to underground layouts and development plans to provide for the future use of excavated areas. END

Fluorspar

Robert B. McDougal

A SUBSTANTIAL INCREASE took place in the domestic production of fluorspar in 1960 over the previous year, reflecting a somewhat improved market condition for the domestic producer. Imports, on the other hand, decreased slightly during this period of time. Fluorspar consumed by industry increased significantly over 1959.

Fluorspar was produced in California, Colorado, Illinois, Kentucky, Montana, Nevada and Utah in 1960. Value of the nearly 241,000 tons produced was about $10.7-million. Output in Illinois accounted for about 58% of the domestic production. Increased output in 1960 was noted in Illinois, Montana, Nevada and Utah, whereas California, Colorado and Kentucky recorded a decline in production. In May, Aluminum Company of America reported that its Rosiclare (Ill.) Works would be closed within three years if the plant could not reduce its cost or production to be competitive in price with Mexican fluorspar. A new company, Minerals Refining Co., acquired the Quo Vadis Mines, Inc., property near Delta, Utah. In 1957 Quo Vadis purchased the mines of the Bell Hill Mining Co. and in 1958 built a flotation plant, which never went into production. Minerva Oil Co. about midyear resumed mining operations at its Jefferson mine, which had been shut down and the underground equipment removed in September of the previous year.

Results of the U.S. Tariff Commission investigation of the domestic fluorspar industry were made public in its report in February 1960. This report was in response to Senate Resolution 163 (86th Congress) authorizing the Commission to make specific findings on further import restrictions, if any—such as import quotas, increased duties or both—so the domestic mining operations could be conducted on a sound and stable basis. The Commission was to determine the necessary course to correct any inequalities in the existing duty rates. Three Commissioners, citing historical precedence, felt that making recommendations for restrictions would be extra-legal, and therefore no recommendations were made.

Later in the year, the U.S. Court of Customs and Patent Appeals handed down an important foreign trade decision. The court ruled that in the "escape clause" cases, the President must accept the Tariff Commission recommendations in their entirety, or the industry would receive no assistance. Subject to appeal to the Supreme Court, the principal effect of the ruling is to give added importance to the Tariff Commission, which has been more sympathetic to industrial demands historically than has the White House. The effect this ruling will have in the future on matters pertaining to fluorspar and other commodities remains to be seen.

Fluorspar prices remained virtually unchanged throughout 1960 following the reduction of prices about mid-1959. The only change that occurred was in November when the price range for Mexican metallurgical grade fluorspar increased $1.00 a ton on rail and barge shipments.

Imports of fluorspar in 1960 decreased nearly 6% in quantity from 1959. Imports, including Government purchases under the agricultural barter program, totaled almost 520,000 tons valued at approximately $14.5-million.

Approximately 647,000 tons of fluorspar were consumed in 1960 and represented an increase of 10% above that used by industry in 1959. Hydrofluoric acid producers consumed 13% more fluorspar than in 1959 due to the continued rise in the requirements for synthetic cryolite and aluminum fluoride for the aluminum industry, and in the fluorine chemical compounds. Steel plants consumed about 12% more fluorspar in 1960 than in 1959, the year in which there was a long steel strike. An average of 4 lb of fluorspar was consumed per short ton of basic openhearth steel produced in 1960. END

Fluorspar Statistics

(Short tons)

	1960 estimate	1959
Domestic shipments:		
Acid grade	142,000	116,700
Ceramic grade	30,000	25,600
Metallurgical grade[1]	69,000	42,800
Total	241,000	185,100
Imports for consumption:[1]		
Containing more than 97% CaF_2	296,000	339,500
Containing not more than 97% CaF_2	224,000	216,200
Total	520,000	555,700
Domestic consumption:[2]		
Hydrofluoric acid	367,000	324,500
Glass and enamel	34,000	35,900
Steel	218,000	194,200
Iron foundry	12,000	13,500
Other	16,000	21,900
Total	647,000	590,000

[1]Includes Government purchases.
[2]Excludes Government purchases.

Phosphate

Finn B. Domaas

TECHNOLOGICAL advancements were of prime importance during 1960. Wet-process phosphoric acid got more of an industry boost than ever before, and an improved phosphate concentrator, which has already been successfully put through pilot-state testing, may receive rapid industry-wide acceptance.

Price competition between the two North African selling groups and the slow recovery of the U.S. export price tended to make the international market situation rather quiet, but with a chance that rapid developments could come at any time during the next year.

Early in the year, Congress passed a bill providing prospecting rights for phosphate on Federal land—a step designed to draw more phosphate exploration and mining activity into the already active western fields. At the same time, San Francisco Chemical Co. (50-50 joint subsidiary of Stauffer Chemical Co. and England's Mountain

Copper Co.) contracted with Western Knapp Engineering Co. for construction of the first of six ore beneficiation units 12 miles north of Vernal, Utah.

Initially, San Francisco's facility near the low-grade 700-million ton Humphreys deposit was to produce about 200,000 tpy of high-grade phosphorite concentrates. When all six units are operative, yearly capacity will be upped to 1-million tons. The firm's ore is being trucked 180 miles to Western Phosphate's processing plant at Garfield.

San Francisco's ventures into the still-virgin and even as yet inestimable phosphate deposits of the West are far from unique. The dramatic breakthrough that headlined late '59 and early '60 phosphate news is still very much in its infancy—but an infancy in an area that might become America's center of phosphate mining activity. (For an outline of the various company projects at the beginning of 1960, see last year's phosphate review, E&MJ, February 1960, p 154).

The most significant technological trend during 1960 was industry's vigorous program to continue pursuing wet-process phosphoric acid. As much as any other factor, the process is causing the current surge of fertilizer activity to appear sound and valid and is making certain that activity will not rapidly weaken. Though wet-process had already been known and used for several years, recent improvements have made it much more attractive to large investors and an instrument for tremendous production step-ups in one particular area — Florida.

The improvements include: more advanced filtration equipment; better corrosion resistance; and better control of reaction time. These have given greater yield of highly concentrated fertilizers and, of greatest importance to the phosphaters, have dramatically boosted fertilizer consumption.

Florida's industrial importance (she's now bidding for the title of world's top producer of phosphate fertilizers) rises with the success of wet-process schemes—the state is the prime U.S. source of high-phosphorus rock needed for the process and is sufficiently close to farm markets. Typical of the high-gear activity was last summer's announcement from American Cyanamid that it would double the capacity of its Brewster wet-process plant to 400,000 tpy—a $10-million expansion.

U. S. phosphate rock production for 1959 gave an idea of just how easily Florida's ore fits into current wet-process schemes. That year, the state, although it only has 40% of the U.S. ore reserve, mined 73% of the rock. The present Florida domination will only be challenged if the massive, low-grade Utah-Idaho deposits can in some way be wet-processed; only furnace acid is presently feasible.

Since wet-process consumes massive amounts of phosphate, and since, in order to stay competitive, a firm would have to place increased emphasis on beneficiation advances, the firm that would gain recognition would be the one that developed a cost-cutting phosphate concentrator. Last year, Virginia's Smith-Douglass Co. gained that recognition.

By having its silica percentage reduced, phosphate becomes concentrated. During usual flotation, anionic chemical (ordinary fuel oil and fatty acid) first lifts the phosphate, then, attached to cationic organic compounds, up goes silica. Smith-Douglass pulled a switch. In an air-operated, no-moving-parts Hollingsworth cell (C.A. Hollingsworth is the company's research director), silica was floated first. As ground phosphate ore, mixed with a chemical, enters the feed distribution box at the top of the cell, water is forced through pinholes in rubber tubes on three levels. Combined action of the water, the air bubbles and the shape of the cell itself circulates the mineral suspension. About 10% more phosphate is recovered from the ore than in conventional cells, where an impeller usually stirs the suspension.

Flotation starts as an amine reagent coats the 1/32-in. dia silica lumps. Since the amine has an affinity for air bubbles, a buoyant bubble of enclosed silica forms. This rises to the surface and overflows the cell. Phosphate, which is not attracted to the amine, simply sinks to the bottom of the cell and is discharged through the underflow.

Because both the cell structure and flotation procedure have been completely altered by Hollingsworth, the Smith-Douglass concentrator unit has no classifier, de-oiling equipment, primary de-oiling cyclone, and secondary screw classifier. The cell's only moving parts are in the pumps and conditioner, where chemicals are mixed with the feed, and in a cyclone, where slimes, which do not mix with the amine, are removed from the ore.

During pilot-plant testing, phosphate recoveries were 95%; 85% is normal in other processes. According to the company, this increase in efficiency could mean an $8-million annual saving for Florida producers alone, and $4-million more if the process proves applicable to rock in other parts of the country.

In 1959, Sylvain Pirson, professor of petroleum engineering at the University of Texas, explained a fluid-mining technique for in situ recovery of phosphate. According to Pirson, two holes (one injection and one production) were drilled into a formation. Sulphur dioxide in water was pumped down the injection well and recovered through the production shaft. It emerged as a mineral-bearing solution from which high-purity dicalcium phosphate could be extracted.

If Pirson's recovery scheme works on production-scale operations, as it has in theory and on experimental wells, several huge phosphate deposits may be tapped. According to State Geologist Jasper L. Stuckey, the two-hole extraction procedure could enable North Carolina to start competing with Florida as a large phosphate producer — approximately 10-billion tons of ore, he said, would become available along the Pamlico River.

Just as the West was tapping more and more low-grade phosphate deposits, and the Southeast was rapidly improving its beneficiation technology, so did the Midwest react to the phosphate boom by giving perhaps faint but, nevertheless, definite signs of possibly becoming a major "wet acid" processor. Pioneer here was National Phosphate Corp., which built a wet-process phosphoric acid plant in Illinois, where its acid will be consumed, and far from customary Florida zones, the rock source. At least two other firms are planning similar operations in the same area.

National's 100,000 tpy (54% phosphoric acid) plant was due onstream by Jan. 1. Florida ore arrives by barge and, from here to the finished-product shipment, the entire operation is automatic. Others nearby with approximately the same capacity are Blockson Chemical, a division of Olin Mathieson, and Allied Chemical's General Chemical Div. If these three do well, many feel that the Midwest's share of phosphate fertilizer processing will increase tremendously.

As the demand for high-concentrate phosphate fertilizer materials increases, so do companies unite to meet that demand. One of last year's important market agreements was the multi-million dollar contract signed by International Minerals & Chemical Corp. and Electric Reduction Co. (Toronto). The firm's vast phosphate fertilizer market goals—include all of Canada and 5% of the U.S.

According to the contract, IMC will ship calcined phosphate rock from its Florida mine to Port Maitland, Ontario, where ERC (subsidiary of the London firm of Albright & Wil-

son) is building a $12-million plant to produce wet-acid phosphate, dicalcium phosphates, triple superphosphates and sodium tripolyphosphate.

International will be the U.S. sales agent.

During the year, two firms struggled for Mexico's phosphate market. Monsanto de Mexico (subsidiary of the U.S. firm) built a $2-million phosphate plant, which could cover all of Mexico's domestic consumption. However, a soap company, which was to have been one of the chief users of Monsanto's trisodium phosphate, announced that it was already committed by a contract to buy its material from Hooker Electrochemical Co.

Not to be outdone by any competitor, Hooker built a $1.5-million plant —also in Mexico and not far from Monsanto's. Either one of the installations could fill Mexico's every phosphate need. Therefore, either one or both of the firms will not be producing at initial rated capacity or the surplus product will have to be exported.

Morocco, always an exporter of large tonnages of crude phosphate, now plans to process its own ore.

Because the manufacture of fertilizers would increase the value of the country's exports fourfold, the Moroccan State Development Organization will invest $50-million to establish a chemical industry at Safi, an Atlantic seaport. Project's first part will be a $24-million plant to produce sulphuric acid at the rate of 1,200 tpd and phosphoric acid at a 400-tpd rate.

Another part of the government's project (and again being carried out by the State Development Organization) is an agreement with the Roval Dutch Shell Groups for constructing and operating an $18-million ammonium phosphate plant at Safi. The 110,000-tpy plant is scheduled for completion by 1963.

The bold move by U.S. phosphate exporters finally to stand up to North Africa's ruthless pricing policies by matching them price-cut for price-cut seems to have worked very well. During 1960, the American export phosphate prices slowly climbed upward to the customary, more realistic levels.

Throughout the year, North Africans were never free from severe competition from export markets. Their greatest competition, however, came from fellow North Africans. The two new sales groups resulting from the dissolution of Comptoir des Phosphates de l'Afrique du Nord (Office Cherifien des Phosphates and Union Phosphatiere Africain) seemed nearing a price war, but (at least for the present) nothing of the sort occurred.

A sales struggle of this type would, of course, have been felt by the American exporters who, if they wished to compete with North African prices in both groups' largest export market (Europe), would have to drastically reduce all prices for perhaps an extended period.

As in previous years, a main theme in export activity was to seek out new markets and local deposits. H. S. Ten Eyck, president of International Ore & Fertilizer Corp., feels that Southeast Asia will soon take its important place on all phosphate export charts. The independent countries of Southeast Asia, he said, are now preparing to expand greatly their agriculture—fertilizer shipments to these countries will therefore skyrocket. However, he also explained, as potential markets increase, so does competition, and the result could be still more cut-throat pricing. END

Free World Production of Sulphur in All Forms

(Millions of long tons sulphur equivalent)

Sulphur Material	1960	1959	1958
Frasch			
United States	4.9	4.5	4.2
Mexico	1.3	1.3	1.6
Total Frasch	6.2	5.8	5.8
Other elemental			
United States	0.8	0.8	0.6
Canada	0.4	0.3	0.2
France	0.8	0.4	0.1
All other	1.1	1.1	1.1
Total elemental	9.3	8.4	7.8
Pyrites			
United States	0.4	0.4	0.4
Europe	3.5	3.3	3.3
All other	2.2	2.0	2.2
Smelter gases and other			
United States	0.5	0.4	0.5
All other	2.2	2.1	1.9
Total production	18.1	16.6	16.1

Sulphur

J. C. Carrington

HIGHLIGHTS of 1960 included record Free World consumption and production, record U.S. consumption and exports, a substantial increase in productive capacity, and a firming of the price of sulphur.

Total Free World consumption is estimated to have reached approximately 17.9-million long tons, a jump of almost 1-million tons over 1959. This was a reflection primarily of the prosperous economy abroad. U.S. demand, slowed by the decline in business activity in the latter part of the year, rose slightly above the previous record of 5,950,000 tons consumed in 1959.

The booming foreign markets led to greater than ever U.S. exports of sulphur. Such shipments—all Frasch sulphur—were estimated to total 1.7-million tons, up 100,000 tons over the previous year. The principal importing countries were the United Kingdom, Canada, Australia, India, and Brazil.

The export record for U.S. sulphur was achieved despite an increase of 600,000 tons in the shipments of foreign producers supplying elemental sulphur to the overseas markets. These gains point up the strong, continuing trend toward the use of elemental sulphur rather than sulphur in other forms.

U.S. production in 1960 was up about 7% over that of the previous year. Output from all sources amounted to about 6.6-million tons, compared with 6,165,000 tons in 1959. Of the total, an estimated 4,950,000 tons came from the Frasch-process mines. Of the balance, 725,000 tons represented elemental sulphur recovered from sour natural gas and refinery gases; 425,000 tons sulphur contained in pyrites; and 500,000 tons sulphur in various forms from other sources.

Imports of sulphur reached a new high of over 900,000 tons. This amount compares with 777,000 tons in 1959. Shipments of Frasch sulphur from Mexico totaled 620,000 tons, or about the same as those of the previous year. Imports of recovered sulphur from Canada increased from 25,000 tons in 1959 to 140,000 tons, while the Canadian pyrites imports held at about 150,000 tons of sulphur content.

Three new Frasch mines came on-stream in the U.S. during the year and two mines were closed. The largest addition is Freeport's Grand Isle project, located seven miles off the shore of Louisiana in 50 ft of water. Next in size is Freeport's Lake Pelto mine on the shore of the Gulf, and smallest is High Island, Texas, mined by U.S. Sulphur Corp. The two mines which were closed at year's end were the Clemens, Texas, and Starks, Louisiana, properties of Jefferson Lake Sulphur Company.

These changes brought to 12 the total number of U.S. Frasch mines now in operation. Texas Gulf Sulphur Co., the world's largest producer, operates four mines in Texas, Freeport five in Louisiana, while Jef-

ferson Lake, Duval Sulphur and Potash Co. and U.S. Sulphur have one mine each in Texas.

In Mexico, three Frasch mines were in operation at year's end, the largest by far being the facilities of Pan American Sulphur Co. at Jaltipan. Gulf Sulphur Co. has a mine at Salinas, and Texas International Sulphur Co. renewed limited production late in the year at Texistepec. Texas Gulf closed its Nopalapa mine in February. Total output of Frasch sulphur in Mexico for the year was an estimated 1,250,000 tons, about the same as in 1959. Shipments were up 200,000 tons to about 1,270,000 tons, virtually all of the increase going to overseas customers.

A major expansion took place during the year in the Free World's capacity to recover sulphur from sour natural and refinery gases. Most of the increase occurred in France where Société Nationale des Petroles d'Aquitaine (Lacq) completed its last two sulphur recovery units to bring capacity up to 1.4-million tons a year.

In the U.S. seven new recovery plants were completed with a combined capacity of 164,000 tons, while four plants with 135,000-ton capacity were completed in Canada. In other areas of the Free World, sulphur recovery units with combined capacity of over 40,000 tons were completed in Brazil, Germany, Japan and the Netherlands.

Further expansion is expected in the near future, particularly in Western Canada, where additional plants for the extraction of sulphur from sour natural gas have either been announced or are under construction. Smaller units are planned in Belgium, Denmark, Mexico and the United Kingdom.

While elemental sulphur supplied the bulk of the increase in capacity last year, and is expected to do so for several years, there has been some expansion in the use of other sources of sulphur. The use of sulphur gases from smelting and refining operations for the production of sulphuric acid increased during the year with the completion of plants with combined capacity of over 30,000 tons of sulphur equivalent in Germany and Spain. Other plants with capacity of nearly 100,000 tons are under construction in Australia, Yugoslavia, Turkey, India, Finland and Sweden.

In Turkey, a project is under way for the use of the sulphur values in anhydrite for production of ammonium sulphate. In India the Sindri plant, which also uses anhydrite, is being expanded. These two projects represent the equivalent of 35,000 tons of sulphur per year. In addition, sulphur-short India has included in its third five-year plan three new anhydrite based plants, which will add the equivalent of over 150,000 tons of additional sulphur, if built.

A small increase occurred in 1960 in the Free World's pyrites capacity. The only significant addition was the Yugoslav government's copper operation near Bor, which began production of pyrites for use in the manufacture of fertilizers. Output was the equivalent of 25,000 tons of sulphur.

On the domestic marketing front, Texas Gulf and Freeport each announced major programs to expand deliveries of sulphur in liquid form, rather than the traditional solid lump form, to customers in the largest consuming areas.

Plans call for new liquid sulphur terminals on the inland waterways, in Florida and on the East Coast, to be served by heated barges and tankers. Texas Gulf will have new terminals at Norfolk, Va., and Carteret, N.J., in addition to its existing facilities at Tampa, Fla., and Cincinnati, Ohio. Freeport will distribute liquid sulphur from terminals near Chicago and Pittsburgh, and at Tampa, Boston, and Bucksport, Me.

The price of sulphur took a modest turn upward in 1960, reversing for the first time the downward trend that began in 1956. The healthy state of business abroad and the continued increase in Free World consumption of sulphur was reflected in increased prices in the overseas market during the latter part of the year and in a firming of domestic prices. END

Potash

Nelson C. White

PRODUCTION and deliveries by the domestic potash industry came into balance after a period of two years of production curtailment to reduce high inventories. Since deliveries continued the climb which has seen them more than double in the past decade, new records were established in both areas.

No significant changes occurred in the use patterns. Approximately 95% of the tonnage was taken by the fertilizer industry; the balance, mostly chemical grade potassium chloride, went to the chemical and metallurgical industries. Electrochemical producers of potash alkalies are the only substantial buyers of potash salts for other than agricultural applications.

Approximately 94% of the tonnage used by agriculture was in the form of muriate; the balance mostly as sulphate and potassium-magnesium sulphate. The trend in physical characteristics toward larger particle size continues but at a slightly slower rate. More than half of present production is in coarse or granular forms (plus 30 mesh).

The new tonnage figure is estimated at 2.6-million tons K_2O or approximately 4.4-million tons of product. Production was up nearly 10% above last year's total of 2.38-million tons and deliveries were 5% over last year's 2.48-million. Domestic deliveries increased only 4% but export shipments jumped 35% to over 0.38-millons tons. The ratio of export to domestic shipments was the highest to date, with exports accounting for nearly 15% of the total, against a range of 10-12% in the recent past. Exports also exceeded imports for the first time in recent history. Imports approximated 0.30-million tons.

With inventories under control and deliveries continuing to increase, the industry is again looking at capacity increases. Little attention had been paid to this area in the preceding three years. Maximum effort had been devoted to two major problems, the demand for better physical quality in product and the necessity for improved efficiencies to help offset the cost-price squeeze. These two problems remain but are perhaps somewhat less urgent than they were previously. The agricultural market continues to stress better particle sizing but, as mentioned earlier, the trend to coarser product has slowed somewhat.

Costs continue to rise in most elements, labor particularly. Contracts negotiated during the year provided rate increases averaging 12¢ per hours, and an incentive bonus system used at Carlsbad since the early 40's was eliminated by incorporating into base pay the average earnings under the plans. Effects of this change on productivity cannot yet be evaluated. One cost element subject to reduction has been explosives. Amounts used have decreased materially with greater use of continuous mining equipment, and in addition, increasing amounts of low-cost ammonium nitrate are being substituted for dynamite. The big change in industry economics resulted from increasing the price tags on its products by approximately 10%, thus restoring them to 1957 levels. With this improvement established in unit revenues, the industry is again looking at the old reliable reducer of unit costs, increased production.

American Potash and Chemical Corp. is completing a construction program at Trona to increase output of all primary products, including a 25% jump in potash. The three oldest producers in Carlsbad, U.S. Borax & Chemical Corp., Potash Company of America, and International Minerals & Chemical Corp., made no significant additions to their existing plants. Expansion of the U.S. Borax plant and mine several years back had provided them with capacity unneeded until now. PCA and IMC were, of course, adding capacity in Canada. Southwest Potash (American Metal Climax) added new mining equipment and put mining on a full three shift per day basis. This provided full load for their refinery and also gave tonnage of ore for sale to National Potash. Southwest also began construction of a new plant at Vicksburg, Miss., to produce potassium nitrate and chlorine from muriate shipped from Carlsbad. Completion of this plant will require further expansion in some Carlsbad components.

Duval Sulphur & Potash completed one of two new shafts being sunk in an orebody approximately 14 miles from the present mill. Ore will be carried by rail to the existing mill. Completion is expected by mid 1961. National Potash (Freeport Sulphur—Pittsburgh Coal) increased production approximately 50% over 1959, mainly through purchasing ore from Southwest. This course has enabled them to continue to delay investment in the second ore reserve, which they purchased in 1957. Thus, three of the six Carlsbad producers will be hauling ore overland by truck or rail in 1961, as their mining areas increase in distance from the refineries. Unfortunately no offsetting improvements in ore grades result from this stretch-out, and the average fell to below 18.5% K_2O from a high of over 25% when the industry became self-sufficient in 1940. Bonneville Ltd. of Wendover, Utah, reported no changes.

Expanding market demands would almost certainly have brought more capacity increases in existing plants in spite of reserve problems, except for the threat of big additions to output from new plants. Five potential new producing units exist that could enter the market within two years. Plans for two of them are indefinite. Farm Chemical Resources Development Corp., which completed a shaft in Carlsbad, near National Potash, over three years ago, has continued development work on plant and process but is not yet ready to start further construction.

Plans of Continental Potash, with a shaft down to 1600 ft near Unity, Saskatchewan, are also vague. But a newcomer to the scene, the third major sulphur producer to seek diversification in potash, Texas Gulf Sulphur Co., has announced its intent to develop the Moab, Utah, reserve delineated by Delhi-Taylor Oil Corp. A contract for the surface facilities has been signed, completion scheduled for 1962. Capacity is announced at 1-million product tons annually. Potash Company of America Ltd., whose Canadian operations started in late 1958, only to be shut down in mid-1959 because of shaft problems, is continuing work to stabilize the ground around the shaft. The work involves use of cement and chemical grouting and is being carried out by Cementation, Ltd. The most difficult phase, stabilizing the Blairmore formation, will occur early in 1961 and the company is reluctant to talk completion dates at this time. On completion, this plant can readily add 600,000 product tons to North American supplies. IMC is now completing its work in the Blairmore formation, in which a heavy cast-iron lining (tubbing) was used for the first time in North America. Surface facilities are 90% complete. Production will start in 1961-62 at a rate of 420,000 annual product tons, but design work to more than double this output has been completed and construction will be scheduled in mid 1961.

Thus, the next three years will see substantial additions to North American productive capacity, totaling up to two-thirds of the present 4.4-million tons. Although North American demands will probably increase only 15- to 20% in this same period, no serious imbalance is contemplated. Carlsbad production needs to be (and will be) cut to stretch out the useful life of this area. World use continues to grow, and to grow faster than the domestic rate. European producers, like those in Carlsbad, can increase tonnage only nominally, leaving it to Russia and Canada to pick up the new load. Satellite demands have curbed Russian and East German shipments to the Free World and are expected to continue to do so. New production from North America should find a ready market. END

Barite

Reginald Rowand

DOMESTIC PRODUCTION of barite declined in 1960 from 1959's figure. It is estimated that 726,000 tons of domestic barite were sold or used by producers, compared to 902,000 tons in 1959. As in previous years, the oil and gas well drilling industry was the main outlet for domestic producers. Approximately 84% of all U.S. barite consumption went to the oil and gas well drilling industry, and the remainder was consumed by the barium chemical and lithophone industries, and by the paint, glass and rubber manufacturers. Again in 1960, Arkansas led in domestic production, with Missouri second and Nevada third. Other states reporting production were Georgia, South Carolina, Tennessee, California, Idaho, Kentucky, Montana, New Mexico, Utah, and Washington.

The domestic barite industry is still far from recovering to the level reached in 1956, when some 1.3-million tons of domestic material were sold or used by U.S. producers. The two principal reasons for this relatively slow recovery are probably: (1) in recent years, more attention has been given to foreign oil and gas exploration, thus reducing the consumption of the prime user of domestic barite, and (2) cost considerations have made it more advantageous to use foreign rather than domestic crude at certain coastal processing plants, especially those plants which supply ground barite to the domestic drilling industry.

U.S. and World Barite Production

(Short tons)

	U. S.	World
1955	1,114,117	2,700,000
1956	1,351,913	3,100,000
1957	1,304,542	3,500,000
1958	486,287	2,600,000
1959	**867,201**	**3,000,000**

Source: USBM Minerals Yearbook.

Although statistics are not available for all of 1960, 499,000 tons of barite were imported during the first nine months of the year, substantially less than the tonnage that was imported for the same period of 1959. The imported ore was primarily for Texas and Louisiana coastal grinding plants, which supply ground barite to the drilling industry.

World barite statistics for 1960 are not yet available. However, world production is expected to show some decrease, compared with 1959 when approximately 3-million tons were produced—500,000 tons less than the peak reached in 1957. In 1956, the U.S. produced 1,351,913 tons, or 44% of world barite production. In 1959, production amounted to only

867,201 tons or 29% of the world's output for that year. This significant reduction in U.S. production has caused many domestic plants to operate far below their capacity in the past several months..

In the future, the domestic barite industry will depend largely on the activities of the oil and gas well drilling industry, and the present level of barite consumption by the oil and gas industry may form the pattern for some years to come. On the other hand, if the oil and gas producers were to renew their emphasis on domestic drilling, the U.S. barite industry could expect to show substantial improvement. END

Asbestos

Colin C. McAneny

ASBESTOS still leads the materials race as a mineral fibrous material that resists high temperatures and attack from alkalies. No synthetic or natural material has yet arisen to challenge competitively its unique position.

Probably the most striking development in the asbestos picture is the vast Soviet expansion in both production and consumption. In addition, the Soviets are selling significant quantities in the Western European (market 61,000 tons in 1959). Though Canada is still the world's largest major producer, USSR is making giant strides to catch up, and may already have passed her in total capacity.

Karl V. Lindell of Canadian Johns-Manville Co., writing in THE NORTHERN MINER, Nov. 24, 1960, gave what is probably the first clear look at the Soviet asbestos industry in recent years. He described progress already made and planned for the future in three asbestos districts. All USSR's production now comes from Asbest, near Sverdolvsk in the south-central Urals. Two other districts are under development: Kiembi, about 220 miles south of Asbest, which will come into production in 1964, and Aktovrak, near the Mongolian border, also due to produce in 1964. We quote here some of his revealing facts and figures:

"The total capacity at Asbest is now 1.1-million metric tons of fibre per annum and will be 1.5-million tons by 1965. Including Kiembi, the total capacity will be near the 2.1-million metric ton mark by 1965. Mill No. 6 (a new mill in final planning stage, which will have a capacity of 450,000 mtpy) will treat ½% to 1½% fibre material presently discarded to waste. Total ore reserves are estimated at 2.8-billion tons."

It is notable that since Canada's yearly production in the last five years has been in the neighborhood of 1-million short tons, Russia's capacity is at least neck-and-neck with Canada's now.

Factors behind the Russians' drive to expand their production include the crying need for more housing, both in the cities and on the farms. In large part this is met by the asbestos-cement industry, which makes corrugated asbestos-cement roof material and asbestos-cement pipes for water and sewer lines. USSR has 30 asbestos-cement plants operating, 18 being built, and 32 more called for in the current seven-year plan.

In 1959, Soviet asbestos exports were 85,000 metric tons, 61,000 to Western Europe and 24,000 to Japan (USBM figures). Indications were that 1960 shipments were about the same. Quality of Soviet fibres, which had been spotty, is now considered high.

Canadian production was high last year. Final figures will not be available till later in the year, but the first eight months of 1960 were above the corresponding period of 1959. THE NORTHERN MINER, foresaw a possible record production year if the last months held up. Previous record-high year was 1955, with 1,063,802 tons shipped. The Canadian export market (traditionally mainly the U.S.) advanced; however Western Europe's heavy demand was responsible for this, as shipments to the U.S. slipped behind last year.

U.S. Bureau of Mines preliminary estimates, based on the first 10 months, were as follows (USBM figures): U.S. imports, unmanufactured, 690,000 st (short tons), value $65-million; apparent consumption 733,-800 st; domestic production, 46,000 st, value $3.9-million; U.S. exports, 2200 st, value $470,000. All these figures, escept for domestic tonnage, were down from their 1959 counterparts. USBM's estimate of total world production was 2,380,000 st, up from 2.270,000 a year ago, Canada and USSR accounting for the increase.

The outlook for 1961 is considered uncertain. Main determining factors will be the trend of residential and business construction in the U.S. and Western Europe, since the bulk of fibre is consumed in asbestos cement and floor tile. Some businessmen see no letup in European demand, while others wonder if it can be sustained. Most U.S. businessmen cautiously predict a midyear upturn in general business conditions, which would include construction; however, nobody seems certain as to when or how strong it will be.

The North American industry's position now is one of ample capacity to meet present and near-future demand. Moreover, many producers have recently completed modernization and quality-control programs. The ample-capacity picture led to some slight price reductions in 1960 in the higher (1-3) fibre grades, though asbestos prices in general have been steady for the last two years.

In asbestos production, Canadian Johns-Manville announced plans ultimately to convert all production at its Jeffrey mine, Asbestos, Que., to open-pit operation. This reversed plans to go wholly to block-caving. Key factor was the decision to install a skip haulage system in the pit, which permits steeper pit sides and obviates haulage roads. The two-skip counterbalanced system, each skip of 30 tons capacity, will be installed and operating by late summer.

Plans are definite for development of the Advocate Mines concession at Baie Verte, Newfoundland. Four companies will combine their efforts as follows: Canadian Johns-Manville, 49.62%, Patino of Canada, 17.3%, Amet Corp., 16.54%, and Financiere Belge de l'Asbest-Ciment, S.A., 16.54%. Total expenditure will be $18-million. The open-pit mine, fibre mill, maintenance and service facilities, and roads and shipping facilities are expected to be in production in late 1963.

In February, Murray Mining Corp. announced discovery of an asbestos deposit in the Ungava region of northern Quebec, of a grade comparable with the Eastern Townships ore. Most recent estimates indicate about 13.5-million tons. Perhaps because the area, located in the northernmost part of the province, is remote and hard to work, no development plans have been announced.

California was the center of considerable asbestos activity in 1960. Asbestos Bonding Corp., subsidiary of Clute Corp., finished the first unit of its new 1000-tpd asbestos plant at Napa in late summer, at a cost of $1-million. Johns-Manville and Kern County Land Co. announced plans to develop a chrysotile body at Coalinga, southwest of Fresno. An open-pit mine, which will produce all group-7 fiber, will serve the growing California market. The initial full-scale mill will have an output rate of 25,000 tpy. Activity by Jefferson Lake Sulphur Co. is reported in Calaveras

1959 Soviet Asbestos Production

	Year Built	Fibre produced — Groups 1-6	Group 7	Total	% Recovery
Mill No. 2*.....	1930	138,000	60,000	198,000	7.6
Mill No. 3.....	1935	246,000	100,000	346,000	11.5
Mill No. 4**.....	1954	54,000	nil	54,000	11.5
Mill No. 5.....	1955	255,000	110,000	365,000	9.6
Total.....		693,000	270,000	963,000	10.1

*Former Mill No. 1 recently demolished to permit mine expansion.

**Construction of Mill No. 4 will be completed late 1960 or early 1961; mill is presently running only a high-grade section treating a concentrated feed. The reject is a low-grade material which will be milled when construction is completed. This plant will add 100,000 tpy to production capacity.

Source: Karl V. Lindell, "Soviet Asbestos Industry Strides Forward," NORTHERN MINER, Nov. 24, 1960.

County; and also in the Coalinga area, Union Carbide and California Minerals have been active.

Arizona's producers in Gila County were active in 1960, following a 1959 slump. Three new mills were built near Globe, to treat ore from the Young area to the north. Fibre is marketed in Mexico and Western Europe; the U.S. Government also is buying 500 tons of Gila County Nos. 1 and 2 crude for the national stockpile.

Leading asbestos producers and consumers continue to emphasize research and development. Johns-Manville, for one, announced that its R&D budget for 1960 was up 10% from the $8-million level of 1959.

A major new domestic market may be slowly on the way to opening up. This is in the field of highway road-surfacing.

When a small percentage (2-3%) of short fiber is mixed with the asphalt used in road-surface preparation, the asbestos stabilizes and reinforces the asphalt binder. Result is a tougher road surface, which better resists cracking due to weathering and has higher resiliency and impact resistance. Such a road is cheaper to maintain.

A secondary benefit, to the contractor, is that the material is easier to work with. The asbestos stabilizer inhibits segregation of the mixture during preparation, and the temperature of handling the stabilized mix is less critical than with unstabilized asphalt.

Developments in this field were reported in ENGINEERING NEWS-RECORD, April 21, 1960. Use of asbestos hikes the cost of road-surfacing by 15-25%. Development of the market, therefore, depends on the cost balance between initial cost of the asbestos and later savings in road maintenance. Some 40 test strips have been installed in the U.S. and Canada in the last 18 months. Significantly, Johns-Manville Corp., a leader in promoting such tests, has had such a test strip on a haulage road in its Asbestos, Que., pit since 1953. In this heavy-duty service the reinforced surface is still performing well, while an adjacent strip surfaced with conventional asphalt paving had to be resurfaced in 1958.

Since state and municipal authorities have to become convinced of the value of the asbestos additive, Johns-Manville is not going overboard in expecting fast new developments. But it foresees a possible new market for 500,000 tpy of short fibre should the market develop.

The field of reinforcing for certain resins may be a growing market for medium and long fibers. Tests have been reported (SAE JOURNAL, November 1959) on use of long-fiber chrysotile to reinforce phenolic and silicone resins for high-temperature uses, as in space vehicles. Neither type of reinforced resin proved satisfactory at very high temperatures, because of fast erosion; but the phenolic type might be usable in nose-cones, and the silicone resin, which showed better staying power under sustained temperatures up to 800°F, might be applicable in structural components or bodies.

PROGRESSIVE ARCHITECTURE reported in February an interesting development in the use of asbestos-cement: a "research house" built in Oklahoma City of asbestos-cement throughout, from kitchen-counter surfaces to decorative trellises along its outside walkways. The material was termed "the 20th Century's first man-made contemporary building material."

Quebec Dept. of Mines has a newly built pilot plant for testing the province's metal and asbestos ores. Designed by Prof. J. U. MacEwan of McGill and located in the St. Malo Industrial Centre, the plant was completed early last year.

Patent no. 2,926.997 (U.S.) was granted to G. L. Kalousek in March 1960 for synthesis of chrysotile. But fibers only 1-3 microns long were successfully synthesized.

Very few developments were reported from the Union of South Africa and Southern Rhodesia, world's no. 3 and 4 producers respectively. For the first nine months of 1960 the following figures were published: South Africa, value of asbestos production, £7,797,225, against £6,730,897 for similar period 1959 (SOUTH AFRICAN MINING & ENGINEERING JOURNAL); Southern Rhodesia, tonnage produced, 100,072, value £5,594,874, vs 88,593 tons, value £5,608,949, for similar period 1959 (CHAMBER OF MINES JOURNAL).

END

NEW BOOKS

Ontario's Mineral Heritage, by L. Carson Brown, director of publicity, Ontario Department of Mines. This reprint from the Canadian Geographical Press presents a popular cross-section of Ontario's mining industry including maps, geologic discussions, mineral output chart and recent significant mining developments in the province. Equally interesting to the layman and the mining man. Released by the Ontario Department of Mines, Toronto, Ont., Canada. 28 pp.

International Mineral Processing Congress, 1960. This report of the proceedings of the International Mineral Processing Congress, held April 6-9, 1960, in London, contains 52 original papers on comminution, classification, flotation, gravity and dense-media separation, magnetic and electrical separation, chemical processing, process study, and control and testing. Published by the Institution of Mining and Metallurgy, 44 Portland Place, London, W.1., England. 1,118 pp. Price $14.50, or £5.

Seventieth Annual Report, Transvaal and Orange Free State Chamber of Mines, 1959. Production statistics, report of the Gold Producers' Committee, proceedings of the annual meeting of the Chamber, costs and earnings of member companies, and accident statistics are included in this report. Published by the Transvaal and Orange Free State Chamber of Mines, Johannesburg, South Africa. 111 pp.

Alluvial Prospecting and Mining, by S. V. Griffith. Chapter headings in this second revised edition include: Prospecting

(*Continued on p. 128*)

Ferroalloys

Bernard R. Henderson
Assistant Editor
Engineering and Mining Journal

Domestic vanadium consumption increased in 1960, despite setbacks in the steel industry; primarily because of increased use in better quality steels. The long-term outlook is favorable. p 124

R. W. Holliday
Commodity Specialist
U.S. Bureau of Mines

and

A. S. Prokopovitsch
Commodity Specialist
U.S. Bureau of Mines

Tungsten mine production increased in 1960, and consumption was the highest since 1951. Imports declined 19% from 1959. Research progress augured a sustained level of production in 1961. p 123

Dr. John M. Warde
Union Carbide Corp.

Manganese consumption in 1961 is expected to approximate 1960's. New foreign sources are entering the market. p 126

Chrome ore consumption in 1961 to equal 1960. Long-range growth looks good. p 125

Wilmer McInnis
Commodity Specialist
U.S. Bureau of Mines

Molybdenum exports and strong domestic consumption put U.S. production at a new high in 1960. Research intensified in production and application technology to meet expected blossoming of demand ahead. p 122

J. H. Bilbrey, Jr.
Commodity Specialist
U.S. Bureau of Mines

U.S. nickel consumption decreased in 1960. Free World production increased. Stocks were higher at year-end. p 121

U.S. cobalt production, imports, prices and consumption dropped in 1960. p 123

Nickel

J. H. Bilbrey, Jr.

FREE WORLD production increased again in 1960, although U.S. estimated consumption decreased slightly. Stocks of nickel at consumers' plants at the end of the first nine months amounted to about 26-million lb, 3-million lb higher than for the corresponding period of 1959.

Free World production for 1960 is estimated at 270,000 short tons, an increase of 7% over 1959. Canadian production for the first nine months of 1960 was a record 159,875 tons, an increase of nearly 20% over the corresponding period of 1959. A total of 12,547 tons (nickel content) of oxide powder and sinter was produced at Nicaro during the first nine months of 1960.

U.S. imports of nickel for the first nine months totalled 67,573 tons (nickel content), over 27% lower than for the corresponding period in 1959. Imports from Cuba for nine months totalled 16,945 tons, down 6% from 1959. (About 1,550 tons of the nickel from Cuba was from the Moa Bay plant of the Freeport Nickel Co.) Imports from Canada, Norway and the United Kingdom were down 17-, 84-, and 36%, respectively.

Nickel Statistics

(Short tons)

	1960 estimated	1958
United States:		
Production	**11,500**	11,606
Imports	**86,000**	122,000
Consumption	**111,000**	112,661
Canada:		
Production	**213,000**	186,341
Exports to U. S.	**69,000**	89,688
Cuba:		
Production	**12,547***	19,658
Exports to U. S.	**15,390***	18,348

*9-mo. figures

U.S. consumption of nickel through September totalled 82,854 tons, a decrease of approximately 1.5% from 1959. Slight upturns in consumption are expected during the last quarter, however, which should bring the 1960 consumption close to the 1959 level. The rather anomalous situation of the nickel imports being lower than the consumption while stocks are increasing, is due to the release of large quantities of nickel from Government stocks late in 1959.

The International Nickel Co. of Canada, Ltd., operated at capacity throughout the year. Estimated production for 1960 is a record 310-million lb. Construction at the Inco project at Thompson, Manitoba, proceeded on schedule. The Kelsey power station at Grand Rapid, on the Nelson River, started to deliver power to the Thompson plant during the third quarter of 1960. Two of the five generating units were in use. One of the three electric furnaces at the Thompson Mine smelter was brought into operation in October, with the other two scheduled to begin operation before the end of the year.

Matte is being stockpiled, pending the opening of the refinery in January 1961.

Falconbridge Nickel Mines Ltd. increased its rate of production again, and 1960 will probably turn out to be the best year in the company's history. By the end of the first six months, production was at the average rate of 64-million lb per year. It is probable, however, that the production for the full year will exceed this amount. Falconbridge, in connection with Marchant Mining Co., is pushing development of the Marbridge Mines property in Quebec. Present plans call for production of ore sometime in 1962.

Sherritt-Gordon Mines Ltd. also operated at a record rate during 1960. Production for the year is estimated at 31-million lb. Construction of a small rolling mill to produce nickel strip directly from powder was well advanced at the end of the third quarter, and the mill was scheduled to start production by the end of the year.

Giant Nickel Mines Ltd. continued to ship nickel-copper concentrates from its British Columbia property to Japan throughout the year. It is estimated that over 4-million lb of nickel in concentrates will be produced during the year.

At the U.S. owned plant at Nicaro, Cuba, production for the first three quarters totaled 12,547 tons. Shipments were considerably higher, as the management strove to reduce the Cuban stocks of finished material to as low a level as possible. Following a statement by the Cuban government that the 25% tax would be applied to all shipments of nickel from Nicaro as of Oct. 1, 1960, the U.S. management announced that the plant would close in 30 days. Before the shutdown procedures could be put into operation, the plant was taken over by the Cuban employes, who announced that operations would be continued. On Oct. 24, the plant was officially seized by the Cuban government.

Construction work on the nearly-completed Moa Bay plant of the Freeport Nickel Co. was brought to a halt early in 1960 by difficulties in obtaining funds. Backers of the project refused to advance the necessary money after it became plain that operations would be impossible under the terms imposed by the Cuban government. The plant managed to get into partial production in December 1959, however, and operated at a limited rate for the first few months of 1960. Several shipments of nickel-cobalt concentrate were made to the Freeport refinery at Port Nickel, La., before the Cuban plant was closed in April 1960. The concentrate, which contained about 3-million lb of nickel, was successfully refined to nickel and cobalt metals in the Louisiana plant, which was then forced to close due to lack of suitable raw material. END

Molybdenum

Wilmer McInnis

U.S. production reached a new annual high in 1960, mainly because strong demand in Western Europe and Japan caused domestic exports to set a new record.

The domestic output of 51,560,000 lb. of molybdenum from all sources during the first nine months of 1960 was up 31% compared with the same months of 1959. Production of molybdenum from the Climax mine in Colorado was up 50% and that recovered as a by-product of copper was up slightly, but the quantity recovered from tungsten ores was off 60% compared with the same months of 1959. All production was from mines in Colorado, Utah, Arizona, California, New Mexico and Nevada, but the first three states accounted for over 95% of the total.

Total Free World production in 1960 was estimated to be about 75-million lb, of which over 90% was produced in the U.S., and almost all of the remainder in Chile, Canada, Japan, Norway, Mexico and the Philippines. All of the output in Chile was recovered from the ores of three copper mines: El Teniente, Chuquicamata and El Salvador. A labor strike at Chuqui curtailed output from that property during the last quarter of 1960. Virtually all production in Canada, Japan, Norway and Mexico was from small molybdenum mines, and that in the Philippines was recovered as a copper by-product.

Although no large molybdenum mines were reported to have been brought into production in 1960, a molybdenite deposit in Sardinia was said to be under development by the firm Mazzacurati and Giacomelli of Rome, Italy, and molybdenum prospects in several countries were under exploration. In the U.S., Molybdenum Corp. of America continued exploration of its large Questa deposit in New Mexico. Favorable results were reported from trenching and drilling of a number of prospects in Canada, and in drilling in the Lake Sanfon region in Sierra Leone.

Domestic consumption of molybdenum contained in concentrate during the first nine months of 1960 increased 17% compared with the same months of 1959, and the production of molybdenum trioxide and other molybdenum products was up 16%. During the first nine months of 1960 total consumption of molybdenum contained in products in making alloys, metallic shapes and chemicals increased 5% compared with the same period of 1959. The quantity used in making steels and other ferrous alloys was virtually the same as the quantity used during the same months of 1959, but molybdenum powder used in making wire, rod, sheet and other shapes increased 27%, and the quantity used in making high-temperature alloys was up 13%, largely because of greater demand for research and development in the missile and space field. Molybdenum used in making pigments and other color compounds decreased slightly, but its use in catalysts increased 45%, and the quantity used in making such products as lubricants and magnetic alloys increased about 5%.

Foreign trade increased sharply during the year, and about midyear some foreign buyers experienced difficulty in locating available supplies. U.S. exports of molybdenite concentrate and molybdic oxide increased from 4.9-million lb of contained molybdenum in the first quarter of the year to 9.8-million lb in the third quarter, and it was estimated that the total for 1960 was higher than in any previous year. Of the 22,549,000 lb valued at $27,736,000 exported during the first three quarters, 3% went to Canada, 82% to Western European countries, and virtually all of the rest was shipped to Japan. All molybdenum exported from Chile during the first half of 1960 went to Western European countries.

The U.S. Government continued the requirement of individual validated licenses for the export of molybdenum ores, concentrates and primary products, imposed by the Export Control Act of 1949, as amended. GSA entered into a contract in behalf of the Federal Government to have molybdenite concentrate in the National Stockpile upgraded to molybdic oxide. Molybdic oxide produced under the contract contained approximately 4.6-million lb of molybdenum.

There were no changes in the prices quoted for molybdenite concentrate and most primary products during 1960. The prices quoted were: molybdenite concentrate, 95% MoS_2, $1.25

lb contained Mo, plus cost of container, f.o.b. Climax; ferro-molybdenum, 58-64% Mo, in lots of 5000 lb or more, $1.76-1.82 lb contained Mo, f.o.b. shipping point, and molybdic oxide, $1.46-47 lb contained Mo.

Research in molybdenum included basic studies to determine selected properties of the metal, its alloys and compounds; stresses and other rock mechanics in mining; and new extractive and fabrication techniques. USBM conducted basic studies to improve mining, beneficiation and extractive methods, and to develop new methods for the preparation of high-purity molybdenum. Other Bureau studies included the preparation and evaluation of molybdenum alloys and compounds, and further development of casting techniques, described in RI 5555, Molybdenum Casting Development, published early in 1960. Similar casting techniques were used by industry in 1960 to prepare special shapes for missiles and other applications. Research by industry and others resulted in methods for the preparation of large single crystals of molybdenum by such methods as arc fusion and electron-beam melting, improved welding techniques, and other valuable technological improvements in the preparation, fabrication, and uses of molybdenum and its alloys and compounds. An experimental plant for fabricating molybdenum and other refractory metals in an inert atmosphere at temperatures up to about 4,000°F. was completed, and for the first time, large size molybdenum sheets up to 48 in. wide and 105 in. long were produced.

Outlook for molybdenum is for continued strong demand with substantial increases in both production and consumption over the next decade. Laboratory studies indicate that new and perhaps lower cost techniques for preparing molybdenum are on the horizon. Coupled with improved fabrication techniques, such developments may lead to a much greater demand for molybdenum metallic shapes and molybdenum-base alloys. These, together with continued strong demand for molybdenum in the manufacture of ferrous and non-ferrous alloys, pigments, lubricants, and other chemical compounds, are expected to keep the molybdenum industry in a healthy position. END

Tungsten

R. W. Holliday and A. S. Prokopovitsch

U.S. mine production was substantially greater in 1960 than in either of the two preceding years, and consumption was the highest since 1951. Imports declined approximately 19% from 1959.

The Pine Creek Mine of Union Carbide Nuclear Co. near Bishop, Calif., and the Climax Mine of American Metal Climax Inc. near Leadville, Colo., were in operation throughout the year. These two mines had accounted for virtually all domestic production from June 1958 through 1959. Early in 1960 two additional mines, the Hamme Mine of Tungsten Mining Corp., in Vance County, N.C., and the Calvert Mine of Minerals Engineering Co. in Beaverhead County, Mont., resumed operation. Shipments from domestic mines for ten months were 338,698 short ton units WO_3 (5,372,420 lb contained tungsten), compared with 163,077 units in 1959 and 148,804 units in 1958.

In the first nine months of 1960, imports totaled 3,942,593 lb. contained tungsten, compared to 4,850,572 lb in the corresponding period of the previous year. Seven countries accounted for 92% of imports. Portugal supplied 25%, Australia 23%, Brazil 20 and Bolivia 12. Burma, Republic of Korea and Argentina each accounted for 4%. The remaining 8% was supplied by the Congo, Peru, Hong Kong, Netherlands and United Kingdom.

Concentrate consumption was at a high rate during the first half of 1960, and although it declined somewhat in the second half, the year's total was highest since 1951. Reported consumption for nine months was 9,124,000 lb contained tungsten. Consumption of tungsten products, including scrap, scheelite added directly to steel, and imported products was in the following approximate proportion: carbide powder (35%), metal powder (26%), scheelite (17%), ferrotungsten (11%), scrap (6%), and chemicals (5%). About 31% of these products was used in the manufacture of cemented carbides and 9% in cast carbides. About 40% was used in alloys, principally steel, and 18% in wire, rod, sheet or forging billets.

According to E&MJ MINERAL AND METAL MARKETS, prices held throughout the year at, or slightly above, the level reached in the last quarter of 1959, after a two-year period at a much lower level. Imported concentrate c.i.f. U.S. ports, duty extra ($7.-93 per short ton unit WO_3) was quoted at $18.50 to $19.00 in December. Domestic prices f.o.b. mine or mill were quoted at slightly below the duty-paid price.

Research efforts by Government and industry were devoted largely to improved fabricating techniques, alloy development and other applications research. Progress was made in forging, extruding and rolling capabilities. Flame spraying of tungsten metal as well as carbides appeared to be gaining importance.

The outlook in 1961 is that new uses, especially in high temperature applications, will hold the consumption of tungsten near the high level of 1960. Expanded steel output, as predicted for the second half of the year by major economists, or increased activity in the nation's mining industry would tend to raise consumption to a level higher than in 1960. Some expanded production may come from the four mines currently operating, and it is possible that other mines may reopen. But no large scale expansion of domestic output in 1961 is foreseen. END

Cobalt

J. H. Bilbrey, Jr.

FREE WORLD production for 1960 is estimated at about the same as in 1959, although U.S. production decreased again. Production is estimated at about 18,000 short tons, compared with 17,700 tons in 1959. U.S. imports of cobalt for the first nine months of 1960 were over 36% lower than for the corresponding period of 1959. The major reason for the cut in imports was the decrease in deliveries of cobalt to Government stockpiles. Imports of metal were much lower, and Canada was the only country for which an increase (8%) was noted. Decreases were recorded for Belgium and the Congo (42%), Norway (13%), Northern Rhodesia (48%), and West Germany (22%). Imports of oxide, chiefly from Belgium, increased 2%. Imports of cobalt concentrates from the Moa Bay plant of the Freeport Nickel Co. amounted to about 300,000 lb (content).

It is estimated that U.S. production of cobalt metal during 1960 will be well under 2-million lb. Domestic producers which operated during the year were the Pyrites Co. (which refined concentrate produced by the Bethlehem-Cornwall Corp.), Freeport Nickel Co. (which refined slurry from

Cobalt Statistics

(Thousands of pounds)

	Metal		Oxide (gross wt)	
	1960 (9 mo.)	1959	1960 (9 mo.)	1959
U. S. production				
U. S. Imports	9,129	20,078	1,119	1,562
Belgium/Congo	6,944	16,364	1,079	1,433
Canada	415	540	40	129
France	43	68	—	—
Northern-Rhodesia	340	983	—	—
Norway	528	746	—	—
West Germany	849	1,377	—	—

(Cobalt content, in lb)

	1960 (9 mo.)	Percent change
Production:		
Salts	275,560	+23
Driers	539,751	−11
Hydrate	81,283	−13
Shipments:		
Salts	272,185	+26
Driers	551,728	− 6
Hydrate	75,737	− 9

the plant in Moa Bay, Cuba), and National Lead Co. Production of oxide for the first nine months increased 115%, and imports increased 3%. Production and shipments of salts and driers are shown in the table.

Consumption of cobalt is estimated at about 9.1-million lb for 1960, somewhat under the 1959 figure of 9.9-million lb. The consumption decline seems to be fairly evenly distributed throughout all end-use categories. The largest single use of cobalt continued to be for the manufacture of permanent magnets. Approximately 27% of the total cobalt consumed was for this purpose, a slightly lower percentage than in 1959. Manufacture of high-temperature alloys took about 21% of the total cobalt.

Bethlehem Cornwall Corp. and National Lead Co. were the only producers of concentrates from domestic ores. The Freeport Nickel Co. plant in Cuba produced some concentrates, which were refined to cobalt metal in the Freeport refinery at Port Nickel, La.

The former Calera cobalt refinery at Garfield, Utah, has been acquired by Minerals Engineering Co. The plant, formerly the largest U.S. cobalt refinery, will be used to produce vanadium from vanadium-bearing slag.

The new copper and cobalt refinery of Union Minière at Luilu was officially opened on May 17, 1960. The plant has a present capacity of 1,750 metric tons of cobalt per year, and tentative plans call for increasing this to 3,500 metric tons per year in 1961.

Production of cobalt metal at the refinery of the Rhokana Corp., Ltd. for the 12 months ending June 30, 1960 rose to 2,614,000 lb, nearly 20% higher than for the preceding 12-month period.

Chibuluma Mines Ltd. increased its cobalt production an estimated 5% in spite of operating difficulties encountered at the Ndola refinery. Other developments in the Rhodesian Selection Trust group of companies included important additions to the Baluba copper-cobalt orebody, the largest undeveloped cobalt reserve in the Free World. Reserves are now estimated at 112-million tons assaying 0.16% cobalt.

African Metals Corp., the U.S. sales agency for cobalt produced by Union Minière, announced another reduction in the price of cobalt metal from $1.75 per lb to $1.50 per lb, effective March 1, 1960. The prices of other cobalt products were also decreased proportionately. END

Vanadium

Bernard R. Henderson

DOMESTIC vanadium consumption increased in 1960, despite setbacks in the steel industry. The increase was due primarily to increased use of the metal for alloy plate, which offset decreased demand for tool steel. Export sales, principally to Europe, rose considerably, reflecting a return to vanadium steel by European steelmakers. The long-term outlook according to one industry official in a recent interview, is for "a steady increase in consumption which is likely to be at a faster rate than the national economic growth."

With American steelmakers offering higher quality steels to consumers, the prospects for vanadium as an ingredient in better grained and tougher steels are good. When the general economy returns to a period of capital expenditure, the demand for vanadium as an ingredient in tool steel should improve markedly.

Basically, vanadium supply and demand are tied to uranium and steel, since most production is a by-product of the uranium industry and most consumption is for ferrovanadium. Production, until recently, has been far ahead of consumption, with the surplus purchased and stockpiled by the government. Last year, however, the government sold 1.5-million lb V_2O_5 to the Vanadium Corporation of America for $1.00 per lb, and is accepting bids for another sale this month. Actually, demand has about caught up with production, and, in the words of one industry leader, "We can probably prove a shortage."

Vanadium Consumption

(short tons)

	1960[2]	1959[1]
Ferrovanadium	1,603	1,492
Oxide	131	152
Ammonia metavanadate	131	112
Other	271	135
Total	2,136	1,891
Export	3,500	1,433

[1]USBM figures, representing about 90% of total.

[2]Est., based on consumption through September.

Although the immediate outlook in the supply and demand picture is for little change, except for continuing use trends, production is bound to be affected by curtailment of uranium production. Ultimately, producers will will have to revert to other sources, such as the roskoelite originally mined by VCA on the Colorado Plateau, or perhaps to the petroleum industry where vanadium is produced as a by-product. Some vanadium is produced as a by-product of phosphate operations in Idaho, but the source is not considered significant. Vanadium production from boiler scrapings and flue dust is significant in Germany and may be an important potential source of the metal in this country. Other potential sources include tailings deposits of some uranium mills and as a by-product of bauxite, such as is being done in France. As a metal, vanadium ranks eighth in order of abundance in the earth's crust, but is widely distributed.

New production sources, in the planning or construction stage, include Kerr-McGee Oil Industries' new vanadium circuit at Shiprock, N.M.; Anglo American's new South African property; and Union Carbide's new Australian property.

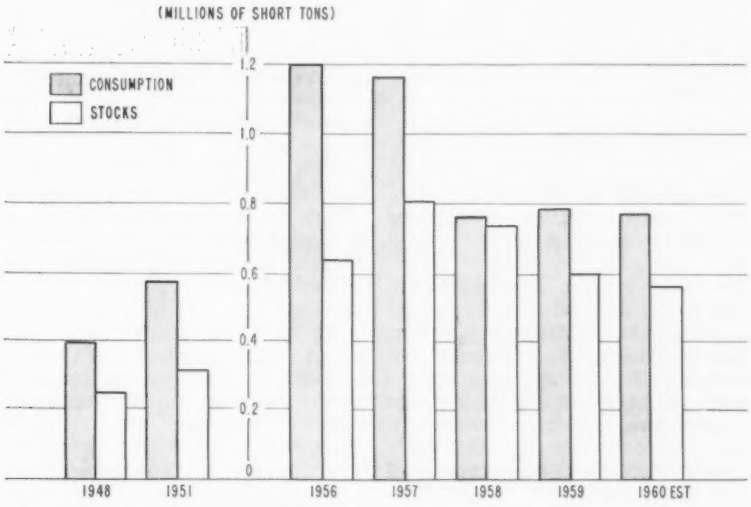
A technique to weld titanium to steel, by which a layer of vanadium is interlayered between titanium and steel, was developed by Union Carbide Metals Co. The presence of vanadium makes the welding possible without affecting the corrosion resistance of steel and avoids the formation of brittle metallurgical phases. Another advantage of vanadium for this purpose is that it is highly fabricable. This technique permits use of thin-gage titanium for lining of chemical containers at prices competitive with rubber and other equipment.

Refractory alloys, using vanadium as one of the ingredients (Cb, Ti, W and Al are the others), have been developed that have four times the strength and 50 times the oxidation resistance at 2000°F of previous alloys. In the field of high-temperature alloys, William H. Feathers, president, Union Carbide Metals Co., commented: "Vanadium, tungsten and tantalum alloys, improved with additives of columbium, titanium and aluminum, may soon be giving better high-temperature strength."

Aside from ferrovanadium, there has been a steady increase in consumption of vanadium in the chemicals industry, notably for ammonia and sodium metavanadate, used as catalysts in various chemical reactions. In this respect, vanadium pentoxide as a catalyst in some sort of automobile exhaust scrubber is one of the methods currently under consideration in the State of California for reducing air pollution. The chemical industry is also making wider use of vanadium in the production of maleic and phthalic anhydrides.

An additional, though limited, use of vanadium is in the nuclear field. Recent purchases by the AEC and Government sub-contractors indicate a future in the metal as a fuel element padding material in a fast breeder reactor and for other classified uses.

END



U.S. CHROME ORE consumption and consumers' stocks at year end are indicated in millions of short tons. Source: U.S. Bureau of Mines Minerals Yearbook.

Chrome Ore

Dr. John M. Warde

THE 1961 Free World outlook is for chrome ore consumption to approximate that of 1960.

The breakdown of U.S. ore consumption by use is 55- to 60% in metallurgy, mainly for chrome alloys used in the production of stainless and heat resistant steels; 30- to 35% in the manufacture of refractories used principally by the steel industry; and approximately 10% in the manufacture of chrome chemicals. This use pattern is believed to be generally representative of that in other Free World consuming countries.

U.S. metallurgical usage could show a modest gain in 1961 over 1960 if output of stainless improves as expected: U.S. consumption in 1960 was about 7% below that of 1959. For the rest of the Free World, the high levels of consumption reached in 1960 are expected to continue through 1961. No appreciable change is anticipated in 1961 in the amount of chrome ore consumed by the refractories industry; U.S. consumption in 1960 was 6% better than 1959 as a result of the increased use of chrome-magnesite and magnesite-chrome brick in open hearth roof construction. The chrome requirements of the chemical industry in the Free World will probably continue through 1961 at the 1959-1960 level of consumption.

At the beginning of 1961 excessive consumer inventories of chrome ore, which were only moderately reduced from the record high of the previous year, were undoubtedly one of the depressants to the ore trade. In the U.S., consumers' stocks at the year end were estimated at 16-month supply in the metallurgical sector, 21 months' supply in the refractories sector and 10 months' supply in the chemical sector based on the average monthly consumption in 1960. A high inventory situation is believed to be prevalent throughout the Free World.

Barter should again play a role in the 1961 chrome market. Offers were outstanding at the beginning of the year for the exchange of U.S. owned agricultural products for metallurgical, chemical, and refractory grade ores. During 1960, deals were concluded under the U.S. barter program for metallurgical ore from Turkey and Southern Rhodesia and chemical grade ore from the Union of South Africa. The U.S. Department of Agriculture announced that at the end of September, the Government's supplemental stockpile included chrome ore in the following quantities: 1,267,000 tons metallurgical, 153,000 tons refractory and 27,000 tons chemical grade. Some of these stocks are in the form of ferroalloys and metal.

All of the domestic chrome ore output in 1960 recorded by USBM came from the Mouat Mine in Montana, operated by the American Chrome Co. Concentrates containing about 38.5% Cr_2O_3 were shipped to the Government stockpile under a long term contract.

U. S. imports of chrome ore in 1960 were down an estimated 20% from the previous year. During the first 10 months of 1960, receipts from Southern Rhodesia surpassed Turkey by more than 2 to 1 to account for over half of the U.S. imports of metallurgical ore. The Masinloc Mine in the Philippines continued to supply the great bulk of U.S. requirements for refractory production, but significant quantities again came from the Union of South Africa for use mainly in furnace maintenance coatings. The Union of South Africa also continued to supply practically all of the U.S. receipts of chrome ore for chemical manufacture.

Free World production of chrome ore improved substantially over 1959. Southern Rhodesia, principal Free World producer of metallurgical ore during the year, operated at a record level. Turkish producers reported a revival in business and good European demand, mainly for high grade lump. The Union of South Africa, major Free World source of chemical grade ore, also operated at an improved rate in 1960, and the Philippine output of both refractory and metallurgical ore showed a con-

Salient Statistics on Chrome Ore in U. S.

(Thousand short tons)

	1948	1951	1955	1956	1957	1958	1959	1960 est.
Consumption for metallurgical use	395	573	994	1212	1177	778	796	**685**
Stocks of metallurgical users	257	305	628	640	849	749	955	**890**
Consumption for refractory use	327	441	431	475	435	312	379	**400**
Stocks of refractory users	237	248	313	432	610	612	729	**700**
Consumption for chemical use	152	199	159	160	148	131	162	**165**
Stocks of chemical users	109	85	169	155	160	176	115	**140**

1/5/61
Source: U. S. Bureau of Mines.

siderable gain over 1959. The USSR was again active in the supply of high grade chrome ore to Western Europe and a Soviet-Japanese trade agreement was announced which is expected to result in exports of Soviet chrome ore to Japan at an estimated rate of 20,000 tons in 1960, 25,000 tons in 1961 and 30,000 tons in 1962.

In the U.S. during 1960, the A. P. Green Fire Brick Co. reported the initial production of chrome containing refractories from its new basic brick plant at Tarentum, Pa., and Columbia-Southern Chemical Corp. late in the year announced plans for the construction at Corpus Christi, Texas of a multi-million dollar facility for the production of chrome chemicals to complement its present output at Jersey City.

Foreign plant expansions, announced during the year, include the completion of a $3.9-million program by A/B Ferrolegeringar, Sweden's principal ferrochrome producer, and a $3.5-million project by Rhodesian Alloys, Ltd., which will double the low carbon ferrochrome capacity of its plant at Gwelo, Southern Rhodesia. Construction was also reported to have begun on a new plant for the manufacture of ferrochrome (and ferromanganese) at Santander, northern Spain, being built for the Spanish concern Ferroaleaciones y Electrometales S.A. Nippon Kokan Kaisha, Japan's largest ferroalloy producer, reported plans for the installation of two 4000 kva electric furnaces at its Toyama plant next year which is expected to help increase its ferrochrome production by 20- to 30% Foundation work is reported to have been completed for a new ferrochrome plant at Antalya, Turkey, controlled by Etibank, a Turkish Government organization, and Pechiney, a French concern.

Developments in the foreign mining sector in 1960 include the announcement that the Malagasy Republic (formerly Madagascar) is expected to become a new source for medium

U. S. Chrome Ore

(Thousand short tons)

	1960 estimate	1959	1958
Imports	**1250**	1554	1263
Production	**106**	105	144
Consumption	**1250**	1337	1221
Metalluegical	**685**	796	778
Refractory	**400**	379	312
Chemical	**165**	162	131
Stocks, end (Consumers)	**1730**	1779	1537

Source: U. S. Bureau of Mines.

grade chrome ore when a $4-million road building program is completed to provide transport for the output from a deposit controlled by Ugine, the French concern. Production from the deposit is reported to be planned at 20,000 to 30,000 tons per year. Faryab Mining Co., a concern controlled by Iran Chrome Co., was reported to be undertaking development of promising deposits in southeastern Iran. Discovery of large low grade chrome resources in northern Finland was announced by the Finnish Geological Survey which reported a first estimate of 15-million tons averaging about 20-30% Cr_2O_3 in a deposit of the "Stillwater complex" type. The Greek Institute of Geology and Subsurface Research announced the discovery of important deposits of chrome ore near Kozani, suitable for metallurgical processing after upgrading. An exploration program was reported underway in Dahomey (formerly French West Africa) where chromite outcrops have been found. A chrome ore concentrator supplied and installed by Communist China is reported to have commenced operation in North Vietnam.

Delivered prices for chrome ore remained at a low level in 1960, partly because of depressed ocean freight rates. The prices quoted for Turkish ore, 3:1, 48% Cr_2O_3 in E&MJ (per long ton, f.o.b. U.S. Atlantic ports) at the beginning of 1960 was $36-$37. In April, the price range quoted for their key grade increased to $36-$38 and continued in this range for the rest of the year. It should be pointed out that these quotations were nominal. Some increase in ocean freight rates is expected by mid-1961 which could affect the delivered price before the year is out.

Prospects for the U.S. ore trade are for an upturn in consumption during the second half of 1961; however users stocks must be appreciably reduced before any significant improvement in the ore market can be expected.

The long range outlook for chrome ore is bright. Applications for stainless steel in industrial and consumer products are growing at rates up to eight times greater than those of other basic materials of construction. In refractories, chrome-containing brick will be in continued demand for basic open hearth construction in the steel industry and increased use of chrome based coatings applied with pneumatic spray equipment for preventive maintenance is gaining wide acceptance. END

Manganese

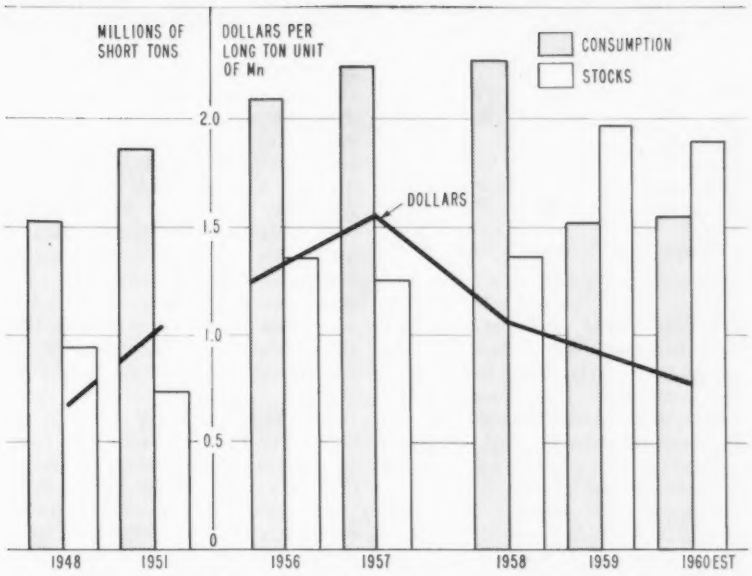
Dr. John M. Warde

U.S. ORE CONSUMPTION in 1961 is likely to be about equal to that of 1960. This outlook is based on the year-end consensus that 1961 steel production—bellwether of the manganese ore market—will approximate last year's total of nearly 100-million tons. In the rest of the Free World, total ore consumption should be about the same as that in 1960 if foreign steel output levels off as observers predict.

As 1961 began, the substantial inventories overhanging the ore market in many of the Free World steel-producing countries had a depressing effect on buyer interest. With most of their anticipated demands already covered by long-term contracts, there was little market activity.

At the close of 1960, users' stocks of manganese ore in the U.S. were estimated to be equivalent to 17 months' supply based on 1960 consumption. This near-record inventory is the result of a three-year accumulation which built up in recessionary 1958, further increased to an all time peak level in strike-affected 1959, and was only moderately reduced in 1960. Year-end stocks in many of the other Free World producing countries were also reported to be substantial.

Barter is expected to continue to be a factor in the manganese market in 1961. Deals were concluded in



U.S. MANGANESE ORE consumption and consumers stocks are indicated by the bar charts in millions of short tons. The price (in dollars per long ton unit of Mn) is shown by the black line. (Source: E&MJ, Indian ore, Mn 46-48%, c.i.f. U.S. ports, duty extra; source for other data, U.S. Bureau of Mines Mineral Yearbook.)

Salient Statistics on Manganese Ore In U. S.

(Thousands of short tons)

	1948	1951	1955	1956	1957	1958	1959	1960 est.
Consumption	1538	1893	2110	2264	2361	1498	1603	**1850**
Stocks (end of year)	964	734	1362	1274	1547	2041	2686	**2500**
Price (¢/LT unit)	63	109	98	140	152	115	91.7	**88.5**

Sources: U. S Bureau of Mines.
E&MJ—Average of high and low quotation for Indian ore, basis 46-48% Mn, per long ton c.i.f. U. S. ports—U. S. import duty extra.

1960 under the U.S. Government barter program which involved the exchange of surplus agricultural products for certain metallurgical grade manganese ore from Brazil and Ghana for battery grade manganese ore from Greece, and for ferromanganese from India. The U.S. Department of Agriculture announced that at the end of September the Government's supplemental stockpile included 35,000 tons of battery grade manganese ore, 18,000 tons of chemical grade manganese ore, 1,051,000 tons of metallurgical grade manganese ore. Some of these stocks are in the form of ferromanganese and electrolytic metal.

New foreign developments are expected to contribute to significant increases in the world ore supply. Facilities at the Moanda deposit in Gabon (Western Africa), with reported reserves of 160-million tons of 48% manganese ore, are expected to be readied for ore shipments early in 1962. The exploiting company is Comilog, a French concern in which U. S. Steel has an interest. Manganese exports from Angola are expected to be stepped up in 1961 as a result of an agreement reported to have been contracted between Companhia Miniera de Lobito and Friedrich Krupp of West Germany. Terms were said to call for delivery of $48-million worth of equipment, including railway and harbor facilities, to enable the Angola company to export 200,000 tons of manganese ore during 1961 (along with 2-million tons of iron ore). Production of metallurgical grade ore from an estimated reserve of about 3-million tons averaging 30% Mn is expected to commence in the New Hebrides by the end of 1961. The operating rate is said to be planned at an annual level of 65,000 tons. Cia. Francaise des Phosphates d'Oceanie, the operating company, is expected to spend over $4-million on the project. Australian production of manganese ore is slated for expansion as the result of Japanese interest. Japanese imports of Australian manganese are estimated at 40,000 tons for fiscal 1961 compared with 17,000 tons during the previous year. Production was reported to have commenced in 1960 at the Grand-Lahou manganese deposits of the Ivory Coast. According to Cia. Mokta El Hadid, the operating company, production is planned at an annual rate of 100,000 tons of ore averaging 47-48% manganese. The first shipments of manganese ore from British Guiana were made during 1960. Communist China's reserves of manganese ore were placed between 50- and 100-million tons with a substantial part averaging 40-50% manganese by Dr. K. P. Wang, U. S. Bureau of Mines specialist. He reported that the Chinese are currently producing ferromanganese and are developing a 1-million ton per year manganese ore industry which would be large enough not only to meet internal needs but allow export. Dr. Wang points out that the Chinese apparently use much more manganese in steel making than western countries because of the greater availability of the material.

Plans were announced during the year for the construction of two new electrolytic manganese metal plants in the U. S.; Foote Mineral, the largest producer, is to build a $6-million plant at New Johnsonville, Tenn. The planned production capacity was reported as 20-million lb per year, half of the capacity to be ready in 1961. American Potash & Chemical, now a major producer of electrolytic manganese dioxide, is planning to construct a $5-million metal plant at Aberdeen, Miss., reported to be scheduled for completion in late 1961. Initial capacity was announced as 10-million lb per year. In the foreign field, construction was reported under way on new ferromanganese plants in Spain, Morocco, India, and Australia and on the expansion of existing facilities in Belgium.

In 1960 U.S. consumption of manganese ore (used principally in the form of ferroalloys) rose moderately over the previous year's total. A feature of this increase was the high level of alloy demand registered in the first quarter when the weekly steel output rate reached record levels. This brisk first quarter activity largely offset the sharp decline in alloy demand that occurred during the rest of the year.

Domestic production of manganese ore (minimum 35% Mn) had reached only 50,000 tons at the end of August when USBM discontinued mine shipment data to avoid disclosure of individual company information. Reason for the sharp decline from previous years was the termination in 1959 of the Government's purchase program.

During the first nine months of the

year, Brazil was again the leading source of U.S. foreign ore supply and furnished about 34% of the imports compared to about 22% from India and 13% from Ghana. Ferromanganese imports were up about 40% over the previous year with India, France, Japan, and the Union of South Africa the principal suppliers.

Output from Brazil's principal producer at Amapa (Icomi-Bethlehem Steel) began showing up in European markets as U.S. demand declined. Ghana was reported to have been active in the Free World market during 1960. Shipments from the Union of South Africa to Western Europe nearly doubled while those to the U. S. showed a small increase. South Africa was again a vigorous contender in the ferroalloy field. Despite the chaotic conditions in the Congo Republic during the last half of 1960, ore shipments, all from Katanga Province, were reported to have been maintained at a normal rate. The USSR continued to be a prime factor in the Western European market, supplying important quantities of ore to the U.K., France, and West Germany. Arrangements for the supply of USSR manganese ore to Japan were made.

India, a major world ore source, had another disappointing year. Production, estimated from nine-month returns, is placed at about 1-million tons, compared with 1.2-million tons recorded in 1959. Faced with stiffening competition from Brazil, South Africa, and the USSR, the value of Indian ore exports in fiscal 1960 was reported to be down about 12% from the previous period. Some pickup was reported at year end mostly because of barter deals. In order to stimulate ore exports, the Government of India announced a reduction in royalty rates to levels which prevailed before June 1958. This action resulted in a decrease of from 12.5% down to 7.5% of the sale price at mine for ore containing a minimum of 45% Mn; for low grade ore the reduction was from 10- to 5%. One bright spot was the increase in domestic ore requirements as India's new ferromanganese industry began to grow. A capacity for production of 93,000 tons of ferromanganese per year has already been installed and an additional capacity of 140,000 tons per year is planned.

U.S. Manganese Ore

(Thousands of short tons)

	1960 estimated	1959	1958
Production	n.a.	229	327
Consumption	1,850	1,603	1,498
Imports	2,650	2,398	2,453
Stocks, end	2,500	2,686	2,041

Source: U. S. Bureau of Mines.

Throughout 1960 commercial prices for manganese ores quoted by E&MJ METAL AND MINERAL MARKETS remained unchanged. Indian and South African ore, basis 46-48%, was listed at $0.87-$0.90 and Brazilian ore, basis 48-50%, was quoted at $0.91. Quotations were given per long ton unit of manganese, c.i.f. U.S. ports, U.S. duty extra. It should be noted that the above quotations were all nominal and do not necessarily reflect actual trading prices. Indications are for a mild increase in ocean freight rates beginning possibly late in the first half of 1961 which could be reflected in ore prices prevailing in the second half of the year.

Prospects for the 1961 U.S. ore market are clouded by the uncertainty of the steel outlook. A major revival of the ore trade awaits a significant upturn in the steel operating rate, which is hoped for in the last half.

In the long term, the apparent trend is for substantial change in the manganese ore business brought about by the increased availability of substantial tonnage from new mines now in the production or planning stage together with a move toward increased ferromanganese manufacture at ore source. END

Copper (*Continued from p. 94*)

commend international production controls (as the lead committee did)? There are many combinations of answers that can provide stronger prices and markets; there are many that can create weaker ones.

Agreement on what constitutes "weak" and "strong" prices will not be reached, partly because costs in copper mining differ so much. On Jan. 11, 1961 custom smelters in the U.S. dropped to 29¢ a lb delivered and producers followed on the 17th. A few years ago many felt 29¢ was enough, but with rising costs few now hold this view. Fabricated product prices were also cut.

Imports of semi-fabricated products into the U.S. continued to disturb U.S. fabricators. Data published by the American Bureau of Metal Statistics, based on Census Bureau figures, suggest that in 1960 net imports of semis were a little under 1959. In 1959 they had been about 4.3% of the total amount of copper reported as consumed in the U.S. by the Census Bureau. The drop in imports this year and the drop in consumption probably leave the percentage about the same.

Net imports of unmanufactured copper into the U.S. took a great fall from 1959. In that year they were about 400,000 short tons; in 1960, based on the first 11 months, it appears they were about 95,000 tons. This follows from the soft demand for copper in the U.S. relative to other areas. U.S. imports of unmanufactured copper were down little from 1959 but exports, almost only in refined form, were up to about 425,000 short tons—in 1959 they were only about 162,000. Not one of the past three years followed earlier patterns, but 1959 was probably more of a maverick than the others, including 1960, and 1960 is somewhat similar to 1958. If one drops 1959 out, there is a trend toward heavier exports of refined copper from the U.S. and a trend also toward lower net imports. Could the U.S. become a net exporter again, or reach a point of "balance"? The U.S. import duty and increasing demand for copper outside the U.S. could do it. It is doubtful it will become a regular pattern, but it seems possible that if again we have periods of poor economic conditions in the U.S. and good conditions outside, the 1958 and 1960 situation could be pushed further.

Copper scrap exports (and net exports) from the U.S. in 1960 were about five times the 1959 figure and almost equally larger than 1958. Japan especially jumped into this market. West Germany and Italy have also gotten U.S. scrap in heavy amounts. The U.S., almost alone among industrial countries, has no restrictions on copper scrap export. Most U.S. scrap users point out that this puts them at a disadvantage and that until the other industrial countries remove restrictions on scrap exports, the U.S. should also have them. END

Books (*Continued from p. 120*)

methods, sampling and evaluation, water supply, sluicing, dry concentration of minerals, forward preparation of overburden, hydraulic mining, gravel pumping, miscellaneous methods of mining, selection of equipment, alluvial diamond mining, and mining of beach sands. Published by Pergamon Press, Inc., 122 E. 55th St., New York 22, N. Y. 245 pp. Price $7.50.

Capital in Manufacturing and Mining —Its Formation and Financing, by Daniel Creamer, Sergei Dobrovolsky and Israel Borenstein. Chapters included in the text are: Measurement of manufacturing and mining growth, long-term growth of capital in manufacturing and mining, trends in capital-output ratios, trends in ratios of fixed and working capital to output, some relationships bearing out changes in capital-output ratios, internal and external financing, and debt and equity financing. Published by Princeton University Press, Princeton, N. J. 343 pp. Price $7.50.

BOOKS presented on this page may be obtained directly from the publisher mentioned in each case. E&MJ does not sell books.

The following publications may be obtained from the Montana Bureau of Mines and Geology, Butte, Montana:

Mines and Mineral Deposits (Except Fuels), Jefferson County, Montana, by R. N. Roby, W. C. Ackerman, F. B. Fulkerson and F. A. Crowley. 122 pp. plus maps. Price $1.75.

Progress Report on Geologic Investigations in the Kootenai-Flathead Area, Northwest Montana, by Willis Johns. 52 pp plus maps.

Columbium-Rare-Earth Deposits Southern Ravalli County, Montana, by Frank Crowley. 47 pp.

Gold and Money Session. 1960 Pacific Northwest Metals and Minerals Conference. This report includes the following papers: Notes for Gold and Money Session by P. R. Hines; Review of Gold Production by D. H. McLaughlin; Gold in the International Monetary System Today by M. A. Kriz; the Problem of Gold Convertibility by O. K. Burrell and How to Obtain a Sound International Monetary System by Phillip Cortney. Published by the State of Oregon Department of Geology and Mineral Industries, State Office Bldg., Portland, Oregon. 57 pp. Price $1.50.

Opportunities Unlimited—Careers in the Mineral Industry, by J. D. Forrester, Dean, College of Mines, University of Arizona, Tucson, Ariz. This profile of the mining industry was prepared to serve as a career guidance aid. It answers basic questions which a high-school student might raise concerning opportunities offered by the mining industry, and educational requirements. Published by the Society of Mining Engineers of AIME, 29 West 39th St., New York 18, N Y 32 pp

The Homestake Story. This booklet describes the Homestake operations in South Dakota. It dispels some of the romance associated with gold mining and shows that gold mining has much in common with other industries. Published by the Homestake Mining Co., Lead, S D. 52 pp.

The following publications may be obtained from the U.S. Government Printing Office, Washington 25 D.C.:

Geology and Ore Deposits of the Kern River Uranium Area, California. U.S. Geological Survey Bulletin 1087-F, by E. M. MacKevett, Jr. 110 pp plus maps.

Geology of the Clay Hills Area, San Juan County, Utah. USGS Bulletin No. 1087-H, by Thomas Mullens, 76 pp plus maps. Price 75c.

Geology of the Grosvenor Quadrangle, Brown and Coleman Counties, Texas. USGS Bulletin 1096-A, by Robert Terriere. 35 pp plus maps.

Illinoisan Outwash in Southeastern Pennsylvania. USGS Bulletin 1121-B, by W. Lockwood and Harold Meisler. 10 pp.

Stratigraphy of the Little Rocky Mountains and Encircling Foothills, Montana. USGS Bulletin 1072-N, by Maxwell Knechtel. 29 pp plus maps.

Geological Survey Research, 1960, a Synopsis of Geologic Results. USGS Professional Paper 400-A, by Thomas B. Nolan, Director. This bulletin contains a summary of numerous investigations made by USGS in the U.S. and foreign areas. Also listed are regional and topical investigations in progress and publications released during 1960. 136 pp. Price $1.

Studies of the Mowry Shale (Cretaceous) and Contemporary Formations in the United States and Canada. USGS Professional Paper 355, by John Reeside, Jr. and William Corban. 121 pp plus map and 58 plates.

Geology and Ore Deposits of the Summitville District, San Juan Mountains, Colorado. USGS Professional Paper 343, by Thomas Steven and James Ratte. 71 pp plus maps. Price $2.

Geology of Glacier National Park and the Flathead Region, Northwestern Montana. USGS Professional Paper 296, by Clyde Ross. 124 p plus maps.

Short Papers in the Geological Sciences. USGS Professional Paper 400-B, by various members of the Survey. Major topics include: geology of metalliferous deposits; geology of light metals; geology of fuels; exploration and mapping techniques; geology applied to engineering and public health; geology of eastern U. S.; geology of western conterminous U. S.; geology of Alaska, Hawaii, Puerto Rico, Pacific Islands, and Antarctica; paleontology; geophysics; mineralogy; geochemistry; and analytical and petrographic methods. 516 pp. Price $4.25.

Deposition of Uranium in Salt-Pan Basins. USGS Professional Paper 354-G, by Kenneth Bell. 10 pp. Price 20c.

The Shape of Alluvial Channels in Relation to Sediment Type. USGS Professional Paper 352-B, by S. A. Schumm. 12 pp.

Gravity Survey of the Western Mojave Desert, California. USGS Professional Paper 316-D, by Don Mabey. 20 pp plus maps.

Classification of Wisconsin Glacial Deposits in Northeastern Ohio. USGS Bulletin 1121-A, by George White. 12 pp. Price 15c.

Botanical Prospecting for Uranium in the Circle Cliffs Area, Garfield County, Utah. USGS Bulletin 1085-C, by Frank Kleinhampl and Carl Koteff. 20 pp plus map.

Engineer's Vest Pocket Book. Index headings include mathematics, buildings, mechanics, heat, hydraulics, pipes, electricity, surveying, costing, mining, chemistry and miscellaneous data. Published by Ottenheimer Publishers, 4805 Nelson Ave., Baltimore 15, Md. 192 pp. Price 90c.

Geology Adjacent to the Great Falls-Billings Line, Great Northern Railway, Montana. Published by the Mineral Research and Development Department of the Great Northern Railway Co., St. Paul 1, Minn. 69 pp plus maps.

Geology of the Orchard Peak Area, California, by Owen T. Marsh. Published as Special Report 62 by the California Division of Mines, Ferry Bldg., San Francisco, Calif. 42 pp plus maps. Price $1.

Elementary Theoretical Fluid Mechanics, by Karl Brenkert, Jr. Once an engineer knows how to use the fundamental equations of fluid mechanics, in contrast to specific formulas, and empirical data, he will have acquired a tool which never becomes obsolete and will help him solve the most advanced problems of fluid mechanics. This text stresses the rigorous derivation and application of these equations, presenting them in a form that will make them usable not only today, but many decades from now. Calculus is stressed, to give the student confidence in using it to solve fundamental problems with math. Published by John Wiley & Sons Inc., 440 Fourth Ave., New York 16, N.Y. 348 pp. Price $7.50.

The Routine Analysis of Copper Base Alloys, by Frank J. Versagi. Elements included in the text are copper, aluminum, antimony, arsenic, beryllium, bismuth, cadmium, chromium, cobalt, iron, lead, manganese, nickel, phosphorus, silicon, silver, sulphur, tellurium, tin and zinc. Published by Chemical Publishing Co. Inc., 212 Fifth Ave., New York 10, N. Y. 168 pp. Price $5.

Crystal Structure Analysis, by Martin J. Buerger. This text formulates the methods, and the theory underlying these methods, for finding locations of atoms in crystal cells. It is designed to provide the reader who has no background in the subject with the theoretical and methodological "equipment" for handling specific problems. Published by John Wiley & Sons Inc., 440 Fourth Ave., New York 16, N.Y. 668 pp. Price $18.50.

Fifty-Sixth Report of the State Mineralogist, by Ian Campbell, State Mineralogist and Chief of Calif. Div. of Mines, Ferry Bldg., San Francisco, Calif. 219 pp.

How the "Average Mining Engineer"

As a contribution to the current lively discussion on mining education sponsored by the AIME in cooperation with industry and educators, the authors have analyzed the curricula of 29 mining schools, and tabulated the requirements of the schools. By pinning down these facts, the authors hope to provide a springboard for future constructive discussion of the mining education problem at the forthcoming AIME convention in St. Louis and elsewhere.

STEFAN BOSHKOV
EDWARD VICKERS

RECENT DISCUSSIONS of the many problems confronting mining engineering education in this country have aroused increasing interest, of both industrial leaders and educators, in reviewing and reevaluating the future of the U. S. mining engineer. The deplorable lack of basic information on the many facets comprising the problem-data that are to serve as common ground and springboards for the exchange of ideas have often led to vacuous discourses and shadow boxing debates. Until industry men and educators jointly put forth the effort necessary to collect basic data, analyze and jointly discuss the findings and significance of such data, we shall both individually and ineffectively chase the blueprint for improvement. And, somehow, it does appear that the greater loser will ultimately be the mining educator, for the mining industry has been able to accommodate itself admirably in the face of the recent slumps in mining engineering enrollments. The onus is on the educator, for he can only sell that which industry will buy.

Of the many factors that define the crossroads at which mining engineering education finds itself in this country at the present, none is perhaps of less importance than the scope and quality of instruction with which the budding mining engineer is imbued while preparing for his profession. It is reputedly here, during his college training, that he acquires the basic tools and knowledge that will serve him worthily and in good stead in his pursuit of high standards of professional competence and citizenship. How well is this accomplished in the present mining curricula? And what image does the average graduate mining engineer project?

The charts purport to present the "average mining curriculum" and the "average mining engineer" graduating in the U. S. with a bachelor's degree. This presentation, although impersonal, may be found deficient in many respects. It does not presume to reflect excellence, nor does it assess educational efficiency and quality of teaching.

It is hoped, however, that this factual presentation may serve as a mirror and yardstick to educators for self evaluation, and serve as a standard to industry in the search for schools that furnish graduates with desirable preparation as measured by deviations from the average. It is interesting that "the average mining engineer" has the image that could have applied to him had he gone to the "average mining school."

Many questions and speculations may be raised on the basis if these data. For instance, the very existence of a large point spread in any one subject in various schools indicates how local conditions and educational philosophy and policy can dictate the composition of a curriculum.

Questions Raised

There are several significant and obvious measurements that tend to define our present educational position; and thereby raise many intriguing questions:

1. The basic science component—mathematics, physics and chemistry—in the curriculum encompasses ap-

Total Requirements, 1959-60

(28 Schools—4 Year Course Average Requirement—147.3 Hours)

	Average required hours	% of schools requiring	% of total required hrs.	% Changes since 1957–58	Requirement range of schools requiring Low	High
Mining, Milling, Metallurgy						
Mining	25.59	100	17.80	+1.30	10	34
Mineral dressing	4.44	189.30	2.68	+0.84	2	12
Metallurgy	3.65	75.00	1.86		2	7
Total			21.94	+2.14		
Geology	15.60	100	10.57	−0.33	5	33
Humanities	28.18	100	19.09	+1.49	11	36
Mathematics						
Basic (through 1 year calculus)	15.47	160	10.48	−1.22	6	21
Advanced (2nd year calculus+)	3.83	28.60	0.74	+0.54	2	6.7
Total			11.22	−0.68		
Basic science						
Chemistry	11.84	100	8.02	−0.38	6.7	26
Physics	10.83	100	7.35	+0.35	8	16.7
Total			15.37	−0.03		
Engineering						
Drawing	4.19	100	2.84	+0.04	2	6
Plane surveying	4.05	71.5	.97	+0.27	2	10
Statics and dynamics	5.05	100	3.42	+0.02	3	6
Mechanics of mtl's	3.83	100	2.59	−0.01	2	7
Electrical engrg	5.13	100	3.48	−0.12	3	8
Fluid mechanics	3.19	82.3	1.78	−0.22	2	4.7
Thermodynamics	2.99	78.5	1.59	+0.09	2	5
Structural design	2.79	35.7	0.68	−0.02	2	4
General	2.04	28.5	0.40	+0.10	1	4
Unclassified technical	3.74	17.85	0.45	−1.71	3	4.7
Technical electives	6.04	57.2	2.34		2	16
Total			21.54	−1.94		

Professors Boshkov and Vickers are on the faculty of the School of Mines, Columbia University, New York.

Is Being Educated in Schools Today

proximately 25% of the total offering.

Does this stamp mining engineering as a scientific field?

Does it certify to the inadequacies of present high school preparation as suggested by the statistic showing that only one-quarter of the schools require mathematics beyond basic calculus?

Does critical assessment of the requisite science tools in the arsenal of the practicing mining engineer disclose the need for such an extensive scientific background, or is this considered to be a desirable mantle of dignity, draped over a semi-professional who aspires to be called an engineer or scientist?

2. The humanities take nearly 20% of the total offering. A recent statistic given in the October JOURNAL OF ENGINEERING EDUCATION estimates the liberal component in all engineering schools in the U. S. at 13.4%. The SPEE estimates the same at 17%. The ECPD's ideal is specified at 20%. In the light of the above:

Is the mining engineer a better "whole man" than other U. S. engineers—or have we succumbed, for better or worse, to pressure an idealogy in leaning excessively in this direction in countermand of our needs to meet equally in all directions with the jack-of-all-trades requirements of our traditional thinking.

3. Mineral industry, or specialty, educators exercise an influence upon the students in about 22% of the total effort, with the mining engineering effort confined to less than 18%. This is the area in which one may expect the maximum professional efficiency. The data reveal that fully 40% of this limited opportunity is spent in course work dealing with the elementary aspects of mining and surveying. Such offerings traditionally lean upon the descriptive and unimaginative presentation.

Is this, then, a fertile area for improvement?

Are the specialty educators clinging to traditional and antique matter to the detriment of the economic aspects of mining engineering that have become of prime importance over the years?

4. There appears to be a definite lack of a planned multi-offering program in the curriculum to express the prominent growth of the industrial engineering approach to mining problems. Few schools offer even an elementary course in engineering statistics.

Is this a result of educational inertia and inability to cope with drastic changes or is it the result of a searching evaluation and determination that the curricula as presently constituted in effect efficiently indoctrinate the student with the industrial engineering approach?

5. Can the educational system in the U. S. adequately prepare a mining engineer in four years?

These are but a few of the many questions that must be answered, such answers will undoubtedly reflect individual thinking in terms of industrial needs and/or educational philosophy, as well as individual assessment of our educational goals. Shall we lean more toward science, or away from it? Shall we try to train a proficient practical engineer or leave the detailed engineering tasks to specialists and concentrate the major effort on trying to create the cement or glue that is necessary to hold the specialists together? Or shall we try to do both and, perhaps, succeed in neither? Shall we tailor our requirements to service the dominating industry in any one school's immediate geographical vicinity, or shall we train the product to fit into a variety of mining enterprises?

Shall we try to resurrect the mining engineering profession by a dynamic and radical change in our educational image, or shall we agree that slumping enrollments are an inevitable by-product of semi-nebulous forces outside the scope of education that eventually will cause the mining engineer to pass into oblivion?

Summary of Mining School Requirements, 1959-60

(29 Schools—4 Year Course Av. Requirement—25.59 Hours—17.8% of Total)

	Average required hours	% of schools requiring	% of total required hrs. (mining)	% Changes since 1957–58	Requirement range of schools requiring	
					low	High
Elementary mining						
Elements of mining	3.46		13.55	+0.69	1	8
Mining methods	3.55	82.8	11.48	−1.53	1	6
Total			25.03	−0.74		
Surveying						
Mine surveying	4.12	96.6	15.58	−3.31	0	8
Design courses						
Mine plant	3.42	68.9	9.21	−1.12	2	6.7
Mine design	3.07	44.80	5.38	+1.58	2	5
Ventilation, drainage, etc.	2.67	65.6	6.86	+0.81	2	4
Materials handling	4.58	31.0	5.55	+0.32	3	6.7
Total			27.00	+1.67		
Analytical Courses						
Rock mechanics	2.29	27.60	2.47	+1.68	1.3	4
Prospecting and development	3.04	37.90	4.50	+0.05	2	7
Mine valuation	2.83	55.20	6.11	−0.07	1.3	6
Total			13.08	+1.66		
Mine economics courses						
Mine management	3.09	65.50	7.94	−0.96	2	5
Mineral economics	2.80	17.25	1.89	+0.78	2	3
Total			9.83	−0.18		
Unclassified						
Mine rescue & safety	1.36	27.60	1.47	−0.43	0	2
Seminars, thesis, problems	2.57	55.20	5.55	+1.26	0.7	4
Associated electives	4.17	20.65	3.36	....	3	6
Total			10.38	+0.83		

Weighted Statistics

The authors have made a similar statistical study of mining school requirements normalized or weighted according to the number of students enrolled at the various schools. The results of this study were so close to the values published in the accompanying tables, that the normalized figures were omitted from this article. For instance, the 21.94 figure in the first table for mining, milling and smelting became 22.61 after being normalized by the number of students enrolled.

PERSONALS

Peter T. Flawn has been named director of the Bureau of Economic Geology and professor of geology at the University of Texas. He succeeds the late John T. Lonsdale as state geologist for Texas.

William W. Watson has been appointed manager of mines and chief engineer of Great Northern Iron Ore Properties. He succeeds William A. Robins, who has retired.

Frederick G. Michels has been appointed director of safety at White Pine Copper Co. He has been manager of safety, claims and employment for all North Range Mining Co. operations in Michigan and Minnesota since 1949.

John G. Reilly has retired as vice president and general manager of the Northern Peru Mining Corp. after five years in Peru. He will continue to live in Lima.

Ross E. Gamble has been appointed mill superintendent by the White Pine Copper Co. He has been with Copper Range Co., parent company of White Pine Copper Co., since 1947.

Gerald R. Gabel has been promoted to the position of production manager for Drummond Dolomite Inc., Drummond Island, Mich.

W. G. Kirkland and **R. E. Paret** have been elected assistant vice presidents of American Iron and Steel Institute by the board of directors. Kirkland's duties will be in the field of building research and technology and Paret's in the promotion of the uses of steel.

S. K. Droubay was elected president of the Utah Mining Association. F. C. Green was named first vice president; Mitchell Melich, second vice president; J. P. O'Keefe, third vice president; and Miles P. Romney, Walter M. Horne and Mildred E. Hollberg were re-elected secretary-manager, assistant secretary-manager and office secretary, respectively.

Donald P. Douglass was appointed deputy minister in the Ontario Department of Mines. He replaces H. C. Rickaby, who retired after 33 years in the public service.

Wilmer H. Kingsford has been appointed assistant to the chairman of the board of Freeport Sulphur Co.

Claude O. Stephens, president of Texas Gulf Sulphur Co., has been named chief executive officer, succeeding Fred M. Nelson, who retired as chairman.

Stephens

Stephens has been president since 1957. He has spent his entire career with Texas Gulf, having joined the company in 1932. He originally served as field engineer, became manager of the company's Wyoming operations, and later manager of the gas department.

L. G. Bliss was named board chairman of the Foote Mineral Co. by the company's directors. He will continue to serve as president as well. The chairmanship had been vacant since the retirement of Gordon H. Chambers in November 1960.

George S. Mikhalapov, president of Brush Beryllium Co., Cleveland, has been named to the board of directors of Beryllium Resources, Inc.

Lester Ziffren has been appointed director of public relations by Kennecott Copper Corp. He was formerly public relations director for Braden Copper Co., Chilean subsidiary of Kennecott, for six years.

Wilson

Bourret

Weston Bourret, mining geologist, has been elected vice president of Utah Construction & Mining Co. With the San Francisco-based construction and mining firm since 1952, Bourret has acted as manager of the mineral development and geology department and will continue in that post.

Also named vice president of the company was **A. M. Wilson,** metallurgical engineer, who has been with Utah Construction & Mining Co. since 1954. He initially managed the company's uranium operations and is now manager of mining operations.

Dr. Donald Hamilton McLaughlin has been awarded the 1961 Charles F. Rand Foundation Award by the American Institute of Mining, Metallurgical and Petroleum Engineers. Dr. McLaughlin was chief executive officer of Homestake Mining Co. He is about to become chairman of the board.

John K. Gustafson will become president of the Homestake Mining Co. early this year, succeeding McLaughlin. Engaged in mining operations since 1930, Gustafson has been vice president of geology and development of the Hanna Mining Co.

Guy Weaver, metallurgist with the Anaconda Co., is the new president of the Montana Section of the American Institute of Mining, Metallurgical and Petroleum Engineers.

Other officers of the Montana Section are Kohler Stout of the Montana School of Mines, secretary-treasurer, and Lester Zeihen of The Anaconda Co., vice president.

Bodge Irwin, assistant manager of Messina Transvaal Development Co. Ltd. (gold mine), has been appointed general manager.

Ronald A. Mudd has been appointed general manager of Bancroft Mine, Northern Rhodesia. He succeeds A. J. Brink, who died recently.

Thomas Anderson, the first engineer ever employed by Eimco Corp., retired on Jan. 1 at the age of 72.

Anderson was chief engineer of the tractor-loader division of the company that produces mining machinery and related equipment.

H. D. Carlson has been elected a vice president of Southwestern Engineering Co. of Los Angeles and named manager of the company's engineering and construction division.

The company also announced the appointment of key engineering personnel: R. D. Koons, manager of engineering; W. K. Ingram, manager of construction; R. Gilman, chief of material section; P. Wendel, chief electrical engineer; J. Locke, chief instrument engineer; F. B. Odasz, chief process engineer; W. B. Dyer, chief structural engineer, and H. C. Morrison, chief mechanical engineer.

Thomas W. Childs and **Wallace Macgregor,** vice presidents of American Metal Climax, Inc., have been elected to the board of directors of the company. They fill the vacancies left by the death of Hans A. Vogelstein and the resignation of Weston G. Thomas.

L. Harris has been promoted to senior research metallurgist with Cerro de Pasco Corp. at La Oroya, Peru.

Richard E. Garner has been appointed superintendent of the industrial engineering department at Kaiser Steel's Fontana, Calif., plant.

Raymond B. Ladoo, consulting engineer, author of major technical works and an authority in the field of industrial minerals, has been awarded the 1961 Hal Williams Hardinge Award by the American Institute of Mining, Metallurgical and Petroleum Engineers.

Clarence H. Sleeman, formerly with the Jones & Laughlin Steel Corp., is now with the Koppers Co., Inc., construction division as chief mining engineer. He is presently working on a development of the El Algarrobo iron ore deposit in Chile.

Paul Bailly was named president of the Bear Creek Mining Co., Kennecott Copper Corp.'s domestic exploration subsidiary.

Bailly

Bailly joined Kennecott in 1952 and has been district geologist for the Central District of Bear Creek Mining Co. in Minneapolis since 1957.

He will be located at Bear Creek's head office in Salt Lake City in his new capacity.

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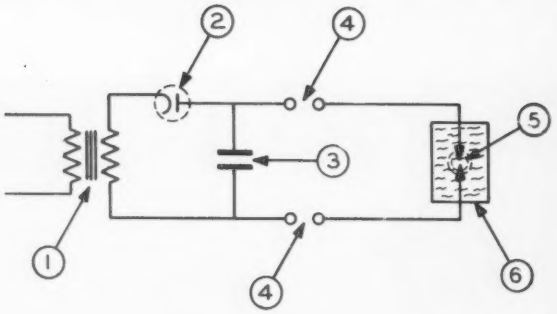

1 - TRANSFORMER
2 - KENOTRON RECTIFIER
3 - CONDENSOR
4 - CONTROL GAP
5 - WORKING DISCHARGER
6 - WATER VESSEL

(THIS CIRCUIT DIAGRAM IS FIGURE 5 OF REFERENCE 3, WITH LEGENDS TRANSLATED FROM THE RUSSIAN)

FIG. 1. BASIC CIRCUIT of electrohydraulic crusher shows high-voltage discharge area in water chamber.

FIG. 2. DISCHARGER, designed by Lev Yutkin, splits a block of granite in a few seconds. See also Fig. 3.

The Electrohydraulic Crusher

B. H. BERGSTROM

IN THE INTERCULTURAL MAGAZINE, USSR[1], the Soviet government has recently announced a novel comminution device that is said to harness the forces which result when an electric spark occurs within a liquid. These forces are created by the spark transmitted through the liquid and also the cavitation impact, which results when the liquid refills the void created when the spark is extinguished. High pressures, amounting to several hundred atmospheres, are said to break up rocks within the vicinity of the spark.

Early Soviet Developments

Prof. L. A. Yutkin of the Leningrad Polytechnical Institute, who first investigated this effect, published the results of his preliminary investigation in 1955.[2] He continued his research, so that by 1957 experimental applications for both crushing and drilling were summarized in a report entitled "Search for New Methods of Crushing Hard Mine Rocks."[3] Later that year, he described his techniques at a meeting of the Mining Institute at Moscow.[4]

The Soviet coal industry is also interested in this method, as evidenced by a symposium on the subject of the electrohydraulic effect, which was held in March 1958. The report of the secretary of the symposium coordination committee, Dr. Protodyakonov[5], has been condensed and translated.[6] A number of institutions were active in the field and about a dozen reports were presented. Some investigators reported indifferent and even disappointing results. Others, notably Dr. Yutkin, gave encouraging reports. He recommended that electrohydraulic type crushers be used to break small rocks where explosives are not applicable, to crush raw materials for optical glass where no iron contamination is permissible, and to bore holes in such materials as granite, iron ore, and concrete.

In view of the various reports, the symposium decided that research should be continued in only four Soviet technical institutes. The Leningrad Laboratory was to be the leader in working out practical designs for industrial-scale equipment. Some progress has evidently been made along these lines, as evidenced by a recent Soviet patent[7] issued to Dr. Yutkin, et al. In the patented device, crushing is performed in a unit which consists of a liquid holding tank containing a conveyor belt for carrying the material, and a positively charged plate which is positioned over the conveyor. The plate is insulated from the tank itself, which serves as the negative electrode.

More recently it was reported[8] that brown coal could be crushed to

Mr. Bergstrom is in the Research Division of the Allis-Chalmers Mfg. Co., Milwaukee, Wis.

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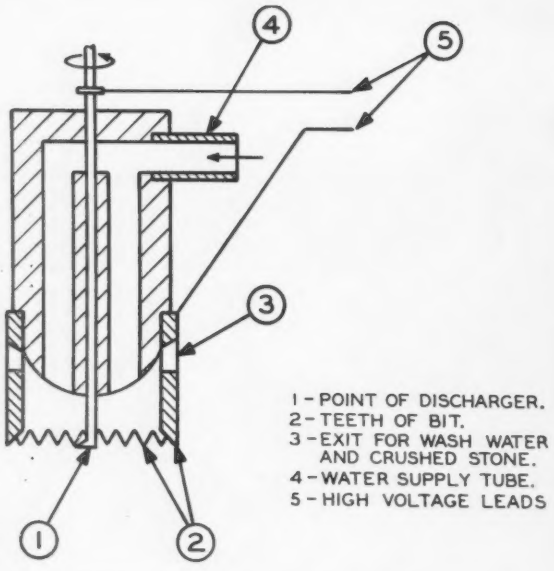

(THIS DIAGRAM IS FIGURE 6 OF REFERENCE 3, WITH LEGENDS TRANSLATED FROM THE RUSSIAN)

FIG. 3. ROTATING POINT of discharger sends sparks to teeth in crown of "drill" in a successive manner.

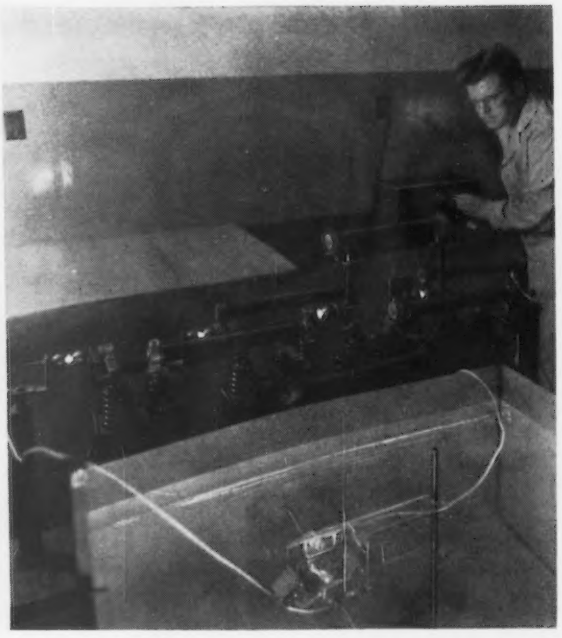

FIG. 4. EXPERIMENTAL apparatus for electrohydraulic rock breaking at Allis-Chalmers research laboratory.

minus 10 microns by a similar device, wherein a continuous succession of discharges cause hydraulic shock pressures as high as 100,000 atmospheres. The coal was not subjected to any considerable chemical change or oxidation in this process, and therefore, valuable elements in the liquid suspension of these fine particles could be recovered by succeeding processes.

How Soviet Crusher Works

The basic circuit for the electrohydraulic crusher is shown in Fig. 1. It consists of a low power (3kw) step-up transformer (up to 100 kv), a high voltage rectifier tube, a bank of condensers of 2 mfd capacity and capable of withstanding high voltages, a sphere gap for control, an underwater discharger gap, and an open vessel of water. High voltage energy from the transformers is rectified and stored in the condensers. When the voltage is built up to a level sufficient to break down the resistance in the underwater gap, and the air gap between the control spheres, the condensers discharge across these gaps. The energy in the underwater spark is partially converted to mechanical work in moving the liquid. Apparently, formation of pressure waves in the water near the discharger combined with the production and rapid expansion of a channel for the high temperature spark discharge, and with the formation of a gaseous state in the zone of the discharge. Essentially, a cavity is generated in the water which quickly grows and surpasses the dimensions of the spark channel. When the spark has ceased, this cavity quickly collapses and produces a phenomenon similar to the collapsing of a cavitation bubble. The effective crushing zone is located in the immediate vicinity of the spark channel.

The Russians have made experiments at voltages up to 100 kv with a 2-mfd bank of condensers, which resulted in energy impulses up to 10,000 watt-seconds each and momentary power pulses up to approximately 100,000 kw. In an apparatus with a 0.7-mfd bank of condensers and with a 4.5 cm long underwater gap, operating at 50 kv, and delivering 875 watt-seconds of energy, the volume of the cavity was about 100 cm^3 and its extreme dimensions were about 8 cm long by 7 cm in diameter. The radius of the effective crushing zone was from 0.3 to 5.0 cm, depending on the duration of the discharge. Soviet experiments have shown that the crushing effect depended on the sharpness of the shock wave fronts. This sharpness of the wave front was influenced by many factors, such as the sizes of the gaps in the circuit, the capacity of the condensers, and the resistance and self-inductance of the circuit, etc. When the front was sufficiently steep, ionization occurred at the air gaps.

The electrohydraulic drill or boring tool, shown in Fig. 2, is schematically diagrammed in Fig. 3. The underwater electrical discharge originates between a rotating central electrode and successive teeth on the edge of the bit. At each successive discharge, some of the rock against which the bit is pressed is broken. The crushed rock is washed out through ports with water which is continually supplied through a tube in the bit. These washings are forced out of the bored hole through the annular space between the walls of the bored hole and the bit. This experimental boring tool was operated at 25 kv, and at a discharge frequency of two impulses per second. The length of the underwater spark was 0.7 cm and the electrical capacity was 0.2 mfd. The energy delivered per impulse was 312 watt-seconds. This tool, when held against a clayey-quartzitic-slate under a thrust of 1.5 kg, had a boring speed of 5 cm/min for a 4 cm diameter hole. When such holes were drilled into granite boulders, the boulders often split as shown in Fig. 2. The granite boulder shown was split after a few seconds of "drilling."

Fast Drilling Speeds

Other examples from the Soviet literature give similar data. Drilling speeds of 0.8 in./min were reported for granite, 3 in./min in iron ore, and 20 in./min in concrete. The capacity of a crusher for breaking rock crystals for the manufacture of optical glass, where no iron contamination is permissible, was about 100

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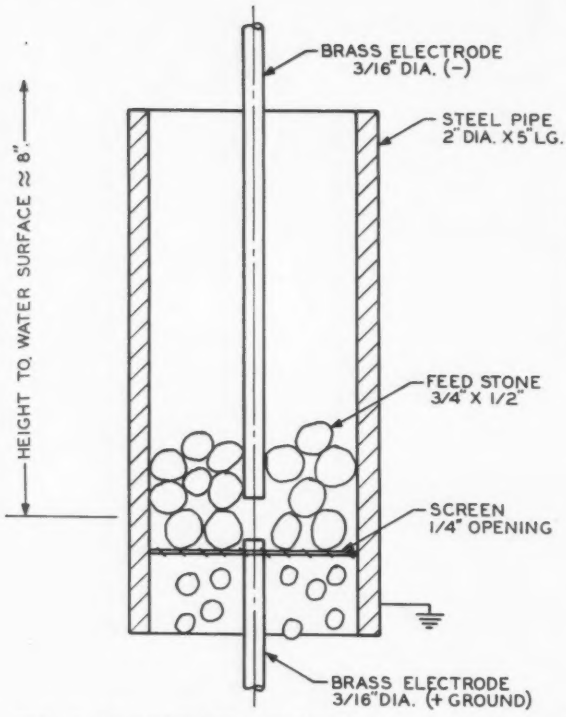


FIG. 5. UNDERWATER ELECTRICAL DISCHARGE of electrohydraulic unit shatters rock near electrodes.

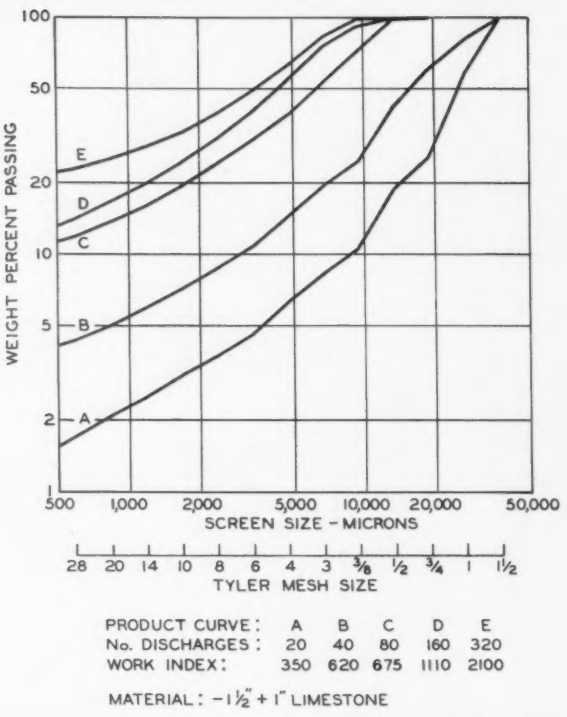


FIG. 6. SCREEN ANALYSIS CHART shows products from an electrohydraulic experiment at A-C laboratories.

lb per hr. Another report states that a 5 kw, 80 kv, and 3 to 33 mfd device could break up to 500 lb of chalk per minute, whereas the chalk could not be readily ground by conventional methods because of its high water content.

None of the examples, however, gave data on the size distribution of the fragments produced by the crushing or drilling operation. Hence, it was not possible to calculate the effectiveness of this apparatus by the Bond Work Index, a measure of efficiency, unless product size distributions were assumed.

If a product size of 100 microns (150 mesh) is assumed, a Bond Work Index of 14 can be calculated for drilling concrete, and 5.7 for drilling a clayey-quartzitic-slate. These work index values are favorable when they are compared to the average values of 25 for gravel, (a major constituent of concrete), and of 7.1 for clay, as given by Bond 9. If, however, the assumed product size was 1000 microns (14 mesh), the respective work index values are 45 and 18, which indicate low efficiencies.

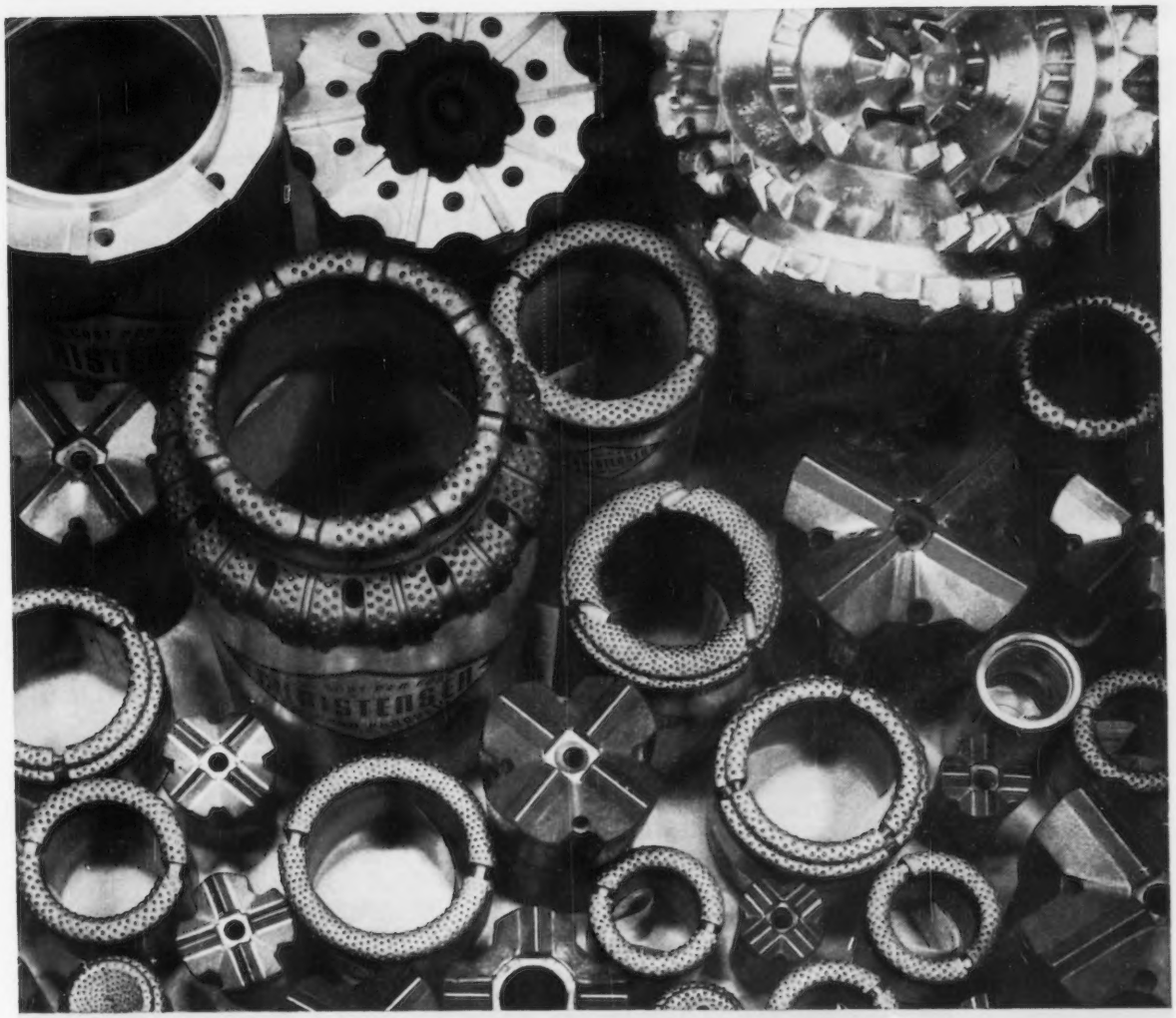
Difficulties encountered by Soviet investigators included a very short condenser life, as exhibited by overheating after a few hundred discharges, electro-erosion of the tips of the underwater electrodes, and failure of the resinous insulation of the underwater electrodes within a short period. Another limitation is that the power supply must preferably be within several meters of the underwater discharge. One Soviet investigator reported that a large part of the energy input to an underwater spark was used for the decomposition of water into oxygen and hydrogen, so that the useful energy for comminution was very limited.

Non-Soviet Research

Few non-Soviet researchers had investigated the use of underwater discharges for comminution prior to the Soviet announcement in the magazine USSR. The only known practical application for electrical discharges underwater, until recent years, was as a spectroscopic light source or as a light source for other purposes.[10, 11] In 1953, an electric discharge was used as a sonic source for underwater echo sounds.[12] In 1956, Early and Martin[13, 14] used the pressure pulses from underwater discharges to punch holes in sheet metal. More recently, Republic Aviation Corp. has been experimenting with this technique as a potential solution to the problem of forming high strength metals which have practically no ductility[15, 16] Explosive forming by electrical discharges would probably be easier to control and safer to use than dynamite and other high explosives currently used[17] in certain forming operations.

Cole[18] reports that underwater discharges have been used to study underwater explosions. The bubbles produced in water by the electrical discharges are apparently similar to those produced by detonations of high explosives underwater.

Very little work had been done until 1956 on the detailed characteristics of underwater sparks. In that year Martin[19] treated the subject as a problem in gaseous conduction at about 10,000 atmospheres. He investigated the size of the spark channel, the energy input, the temperature, and pressure as functions of time and carried out a particle balance and an energy balance as functions of time. His study concerned the underwater spark produced by the discharge of 5.8-mfd capacitor charged to 25 kv which delivered 1812 watt-seconds of energy. The copper electrodes were 1.5 cm apart and the spark was initiated at a one-mil tungsten wire across the gap. At the moment of peak current, which occurred 1.9 microseconds after initiation of the current flow, the current was 85,000 amp, the pressure of the spark channel was 8330 atmospheres, and the spark



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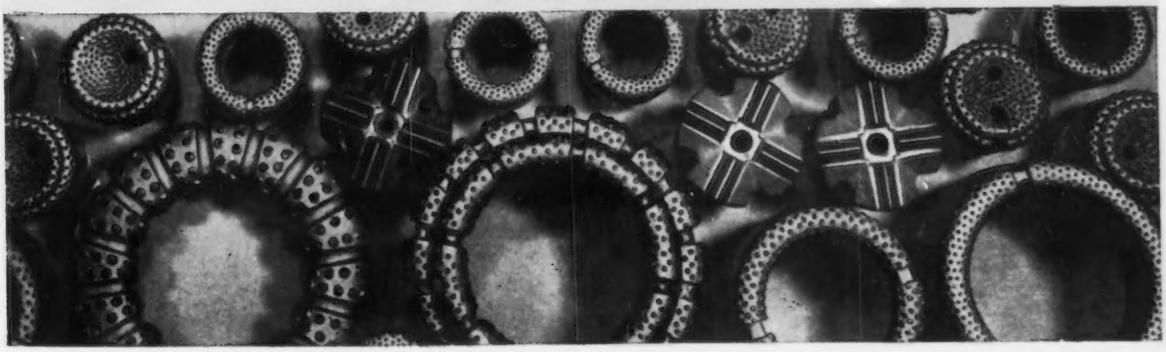

channel radiated a spectrum corresponding to a black body at 29,950 deg Kelvin. The total particle density in the channel at that moment was 2×10^{27} per cu m and these particles consisted primarily of dissociated oxygen and hydrogen which were about 30% ionized.

The major energy loss during the early stages of the spark was that of the shock wave. In the later stages, radiation was the major form of energy loss. This light flash had a duration of 28 microseconds. Because almost all of the energy input to the spark channel occurred in the first four micro-seconds, this extended period of 28 microseconds showed that energy was stored in the spark channel and was radiated as the channel expanded and decreased in temperature. The high pressures reported were developed by the mechanical inertia of the water which exerted a nearly rigid opposition to the expansion of the spark channel.

A-C Started Research in 1952

The only non-Soviet experiments known to the author for crushing rock by means of the electrohydraulic effect were conducted in the Research Laboratories of the Allis-Chalmers Manufacturing Corp. Exploratory work of this nature was conducted as early as 1952, prior to the earliest Soviet reference on the subject. In his exploratory work, sporadic fracture of travertine and limestone was accomplished.[20] In a more recent series of experiments various experimental conditions were explored wherein the voltage ranged from several thousand up to 80,000.[21] At 10 kva and 100 watt-seconds of energy small particles were consistently abraded from minus 3 plus 4 mesh limestone placed in the vicinity of the underwater spark, but the work index was about 1000 which indicated that the process was extremely inefficient. At 20 kv and 200 watt-seconds of energy the crushing effect was only slightly improved. The best crushing effect was obtained when 200 watt-seconds of energy was delivered at 80 kv to the spark by means of a parallel charge-series discharge Marx generator. See Fig. 4. When the open screen device illustrated in that figure was replaced with the two-inch diameter pipe apparatus sketched in Fig. 5, a work index of 76 was obtained for the crushing of ¾ by ½-in. limestone. In this experiment, the sample of stone was subjected to ten successive sparks before the product was screen analyzed.

This value of 76 for the work index was still quite high when compared to a value of 12 obtained with conventional crushers. A factor not used in this calculation was the efficiency of the electrical apparatus for charging the capacitors. In the particular circuits of these experiments the electrical efficiency was probably close to 50% which means that the work index values for all the electrohydraulic experiments previously mentioned should have been doubled; this unfortunately indicated that the work indexes were even more unfavorable than was at first apparent.

Another series of experiments[22] was performed in a deep, 4-in. diameter, water filled hole in a 9½ in. dia steel vessel. At 36 kv, and 970 watt-seconds of energy, samples consisting of six pieces of minus 1½ plus 1 in. limestone were bombarded with up to 320 successive discharges. Fig. 6 shows that the size distribution was definitely finer after these treatments but that the work index became exceedingly high after numerous shocks.

It was observed in these experiments that no marked change in the appearance of the rock specimens occurred in the first several discharges. Additional discharges resulted in fine cracks on the surface of the specimens. Continued discharges caused the disintegration of the specimen into several pieces including a quantity of fines.

Other observations have shown that water was definitely disassociated by the discharge and that high pressures were involved. Oscillograph records show that the discharge took place in about 5 microseconds and that the duration of this period was a function of the length of the underwater gap.

An Inefficient Process

The electrohydraulic method of comminution recently announced by the Soviet press, while a novel approach, appears to be a very inefficient process when carefully scrutinized. Further developments may see its application in certain specialized fields such as the crushing of raw material for optical glass where no iron contamination is permissible, and in the disintegration of weakly bonded, wet materials such as chalk.

Unfortunately, Soviet published data was incomplete for a proper evaluation. The best performance obtained at Allis-Chalmers was at an energy expenditure at least ten times as great as with conventional crushers. Allied problems, such as the short life of the electrical components as reported in the Soviet literature, and the inherent danger of high voltages to untrained personnel, seem to indicate that this type of apparatus will have only a limited field of application.

Acknowledgments

The able assistance of L. Anderson and others of the Research Laboratories are gratefully acknowledged. Thanks are due to E. Kaeser and D. Peterson of the Staff Engineering Laboratory for permission to refer to their work. Thanks are also due to C. L. Sollenberger, supervisor of mechanical and process research, and W. Mitchell, Jr., director of research, for their advice and suggestions.

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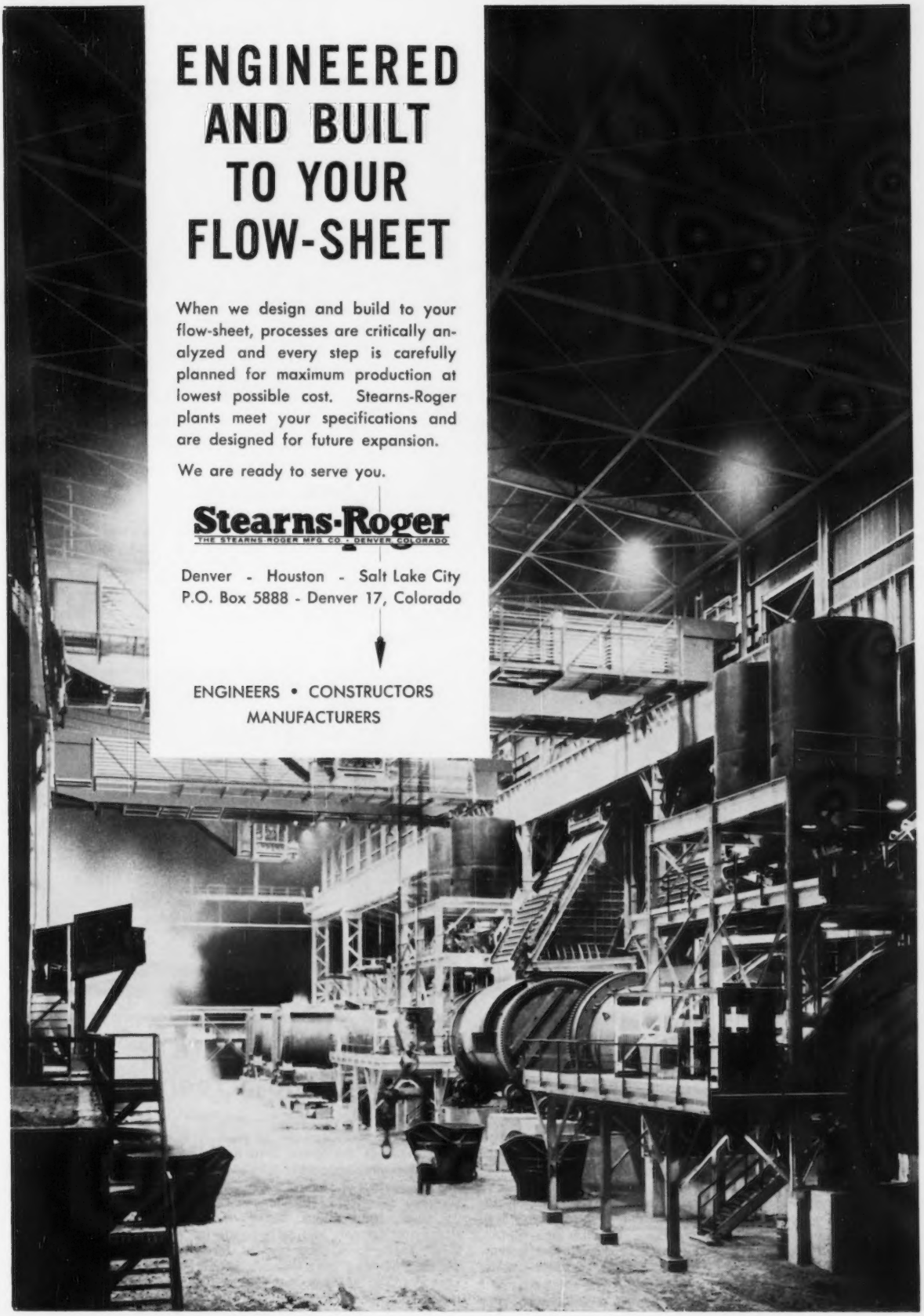
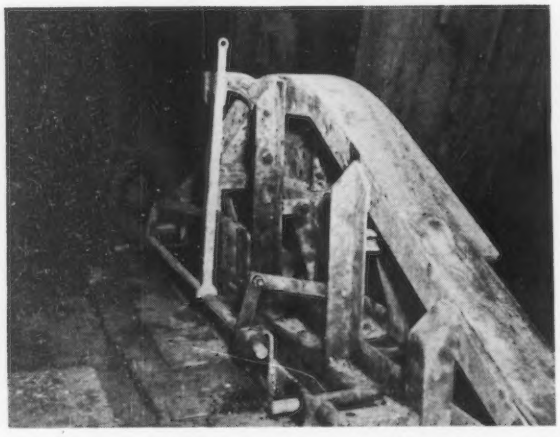


OPERATING IDEAS



A LEVER-ACTUATED, movable station dump has proved less troublesome at Butte than air-cylinder, movable dumps.

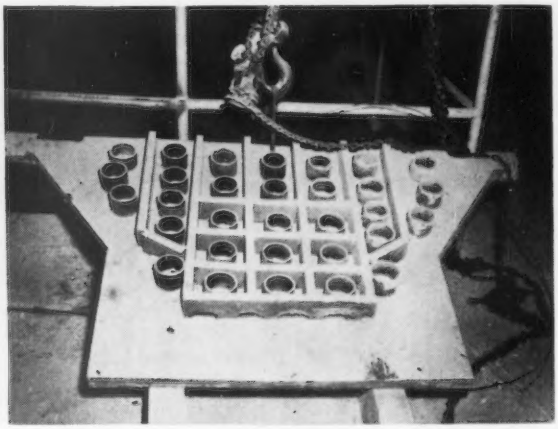
Left, mechanism is in dumping position; right, mechanism is retracted. Note stop plates to hold mechanism in dump position.

Butte Builds Lever-Action Movable Station Dump

BY SUPPLYING a stationary station dump with a lever mechanism, Anaconda Co.'s Butte mines have devised a home-made movable station dump for Granby-type cars.

Advantages claimed for the lever-action dump over air-cylinder movable dumps are: (1) Elimination of the use of compressed air, (2) elimination of maintenance of the air cylinder, (3) prevention of dump slippage and subsequent station wrecks, (4) increased dumping efficiency and (5) elimination of the cost of cylinders, base sheets, fittings, etc.

Normally, a great deal of such maintenance is required to keep air operated dumps in good order. One-cylinder dumps are troublesome because only one end is positively held. The idea was originated by Paul Wells, shift boss at the Steward Mine, Butte, Montana.



A COMBINATION of T-1 steel bars and manganese plates is arranged to retard velocity of rock and to give it a rolling motion instead of a sliding one. A certain amount of rock remains on the surface, with the result that rock flows on rock.

Rock-on-the-Rocks Triples Life of Chutes and Screens

THE MECHANICAL engineering department at Butte has developed a technique to triple the life of the vibrating screen and liners at the Berkeley crusher and conveying system.

Manganese plates are welded on T-1 steel bars. Next, short strips of manganese bars are fixed on the flat surface of the screen, and upright pieces of manganese welded onto them at a 90° angle to the wearing surface. Because this retards the velocity of the rock and gives it a rolling motion instead of a sliding one, the life expectancy of one of these screens is now triple that of the original screen. Approximately the same method is applied to the liners throughout the conveying system. A certain amount of rock now remains stagnant on the surface of the liners, with the result that rock flows over rock, thus prolonging the life of the liners.

The original Berkeley screens were constructed of smooth-surfaced T-1 steel. Although the steel had good wearing quality, such a tremendous volume of rock had to be transferred that improvements had to be made in order to reduce "down-time" for repairs. The first of these improvements was the welding of used tungsten-carbide bits to the top of the T-1 steel bars. This increased the wearing quality and led to the development of the present method.

United Electric Coal Co. equips new 45 cu. yd. shovel with Yellow Strand

Along the banks of the Illinois River at Banner, Illinois, a new 45 cu. yd. shovel works day and night on a stripping operation. Every 8-hour shift 17,500 tons of shale, rock and clay overburden are stripped to reach a high quality coal seam 35′ below ground.

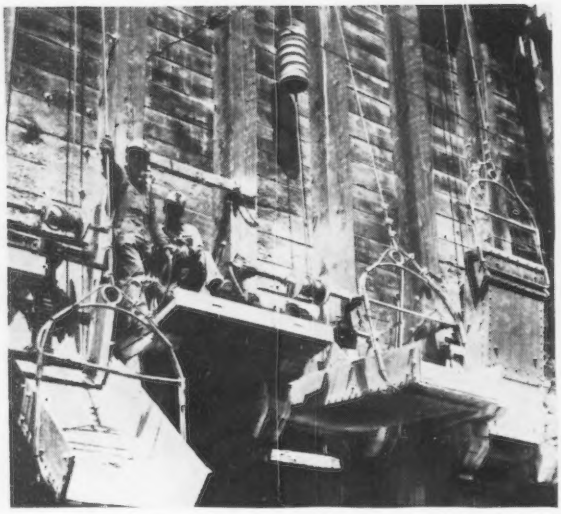
Banner is the first coal mine, built on a river bank, with a conveyor 600′ long, to carry coal directly from preparation plant to river barge. Production at Banner Mine is 4,000 tons daily.

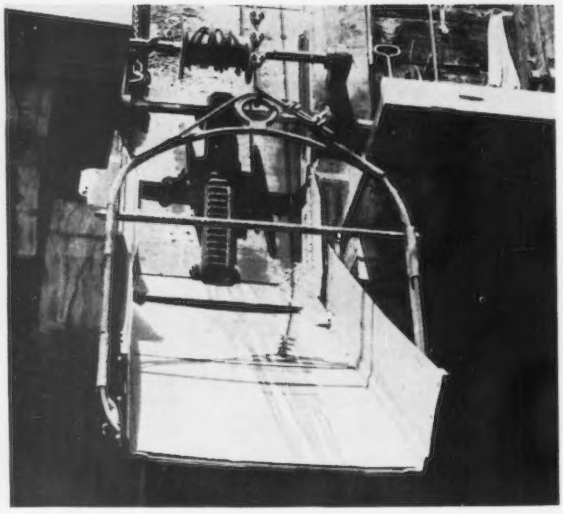
Because each operation must go like clockwork, United Electric Coal Co. specifies Yellow Strand Wire Rope. Among the various rope sizes, the big shovel's two main hoist wire ropes of identical lengths are 544′ of 2¼″ 6 x 41 Yellow Strand Right Lang Lay, IWRC with tapered ends and welded with becket loops. Two other shovels at Banner, plus a dragline and barge puller, are 100% Yellow Strand.

No matter what size wire rope, for large or small shovels, Yellow Strand can be depended upon to be trouble-free. Yellow Strand engineers will be glad to help you solve your shovel wire rope problems. Call them soon. *Broderick & Bascom Rope Co., 4203 Union Blvd., St. Louis 15, Mo.*

Yellow Strand.
WIRE ROPE

OPERATING IDEAS *(Continued)*





BY ADDING a safety cable to the bail on each chute at Anaconda's Badger State Mine, workmen are protected from the danger of falling counterweights in case the bail should break. Cables are threaded through pipes welded onto the bail.

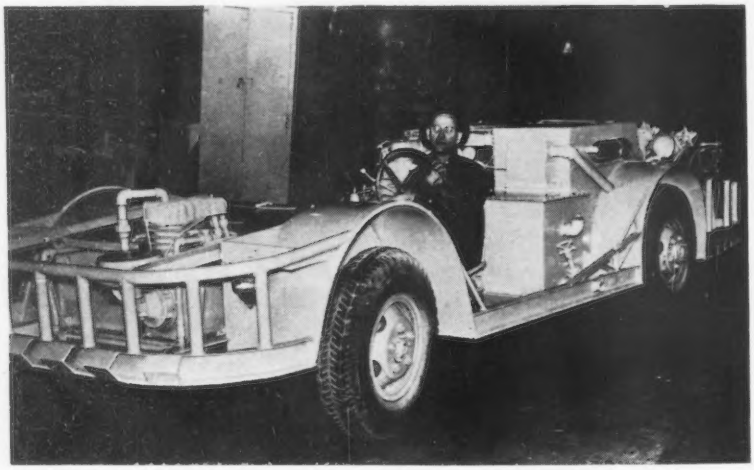
Safety Cable Protects Chutemen at the Badger State

RAYMOND M. BAROTT, Butte, suggested that mine safety cables be put on each chute at the Badger State Mine so that, if the bail on the chute breaks, the counterweights cannot fall and hurt a man standing on the platform.

The cables were installed and, according to a report from the mine's Bureau of Safety, provide adequate protection for the chutemen.

As shown in the picture on the left, the counterweights are suspended a considerable distance above the men when the chutes are lowered. The photo on the right illustrates how the safety cable is threaded through pipes welded onto the bail. The chute door is actuated separately.

Mr. Barott, who originated the idea and installed the cables, is boss of the structural iron workers.



ON IMC'S new service car, an air compressor on the front furnishes air for the tires of mining equipment and supplies pressure for grease guns mounted on the rear.

IMC Builds Unique Service Car

INTERNATIONAL Minerals & Chemical Corp. has built a car with the engine in the middle. It is a service car that works underground in IMC's potash mine at Carlsbad.

The design permits both front and rear ends of the vehicle to be used for mining equipment.

Only 48-in. high, the low silhouette is functional, allowing the service car to go through low-ceiling drifts to the mine face.

On the front end of the car is an air compressor. It furnishes air for tires on jumbo drills, undercutters and shuttle cars at the face. The compressor also furnishes air for the pressure grease guns mounted on the rear.

The service car has solved the problem of getting lubricating materials and equipment into the far reaches of the mine.

Starting with a transmission and diesel motor from an old Jeep, body and frame were fabricated in the mine's maintenance shop.

Film Protects Ingots

AT THE ALTON, Ill., plant of the Federated Metals Div. of AS&R, one-ton bundles of ingots are stored in large polyethylene bags from the time the metal is cooled until it is shipped.

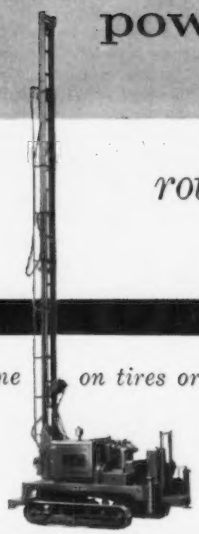
By controlling moisture condensation on the metal and preventing dirt and dust contamination, these bags help ensure the delivery of unblemished products. The company had previously tried paper covers in its Detroit plant, but repeated breakage discouraged continued use.

Bags used in the Alton plant are supplied by Bemis Bros. Bag Co. and made from Bakelite polyethylene, a product of Union Carbide Plastics Co.

LE ROI LRD-2 for low cost,

powerful rotary drilling

rotary or down-the-hole drilling
. . . gas or diesel



These rigs come on tires or tracks!

Here's a highly portable blasthole drill for drilling holes up to 4½ inches as deep as 30 feet . . . equipped for either positive-drive rotary drilling or powerful down-the-hole percussive drilling.

What's more, the LRD-2 is completely self-contained . . . and economically priced, too!

The entire unit is easily handled by one man. Controls are conveniently grouped at an operator's station located alongside the drilling area. The unit can be moved, leveling jacks hydraulically set, mast hydraulically raised, drill pipe and bits connected, and hole started all with a few non-fatiguing motions.

Powerful direct mechanical drive keeps the rotary table turning — won't bog down or lose torque under rough going like air or hydraulic driven units — eats through tough rock formations under 10,000 lbs. pulldown pressure at speeds from 40 to 250 rpm. If necessary, a hard-hitting down-the-hole drill can quickly be substituted for the rotary bit to drill extremely hard rock formations.

A Le Roi 25 hp two-stage air compressor provides ample air for powering the down-the-hole drill and cleaning out hole . . . or is available in single-stage where only rotary drilling is necessary.

The self-propelled LRD-2 is available either on crawler or tire mounting and with either gasoline or diesel power unit. A whole list of extra equipment is available to ease or speed drilling, including lights for night-time operation, a mounted bit grinder, air hoist, breakout tongs, water injection system, . . . all detailed in Specification Sheet AT-146. Write for your copy.

AT-018

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WHAT'S NEW IN PATENTS

OLIVER S. NORTH

U. S. PATENTS

Metal and Mineral Processing

Process for preparing dense sodium carbonate from crude, dry-mined trona ore. L. Seglin and H. S. Winnicki, assigned to Food Machinery & Chemical Corp. U.S. 2,962,348.

In the recovery of gallium from high-alumina ores or substances, the source material is heated to above 1000°C in a reducing atmosphere to volatilize gallium oxide and alumina. The resulting vapor is condensed to produce a gallium-enriched condensate. L. M. Foster and G. Long, assigned to Aluminum Co. of America. U.S. 2,962,370.

Process for simultaneously extracting columbium and tantalum values from an acid feed solution to produce a mixture of those two metals substantially free from other metals, especially transition metals. The material is dissolved in hydrofluoric acid, and the solution then further acidified and treated with an organic solvent to co-extract the columbium and tantalum values. R. A. Foos and H. F. Gemperline, assigned to Union Carbide Corp. U.S. 2,962,372.

In a method for rapidly settling mineral particles from suspension to produce a thickened, high-solids sludge, the intermediate settling zone is subjected to compression and kneading actions as well as to raking. Examples are cited showing use of this method for rapidly settling a zinc concentrate from suspension, thickening a run-off suspension of gold ore from a cyanide leaching plant, and settling clay slimes in a sylvinite beneficiation operation. E. Kuss, D. Remagen, E. Rosin and H. Schackmann. U.S. 2,963,157.

In the economical recovery of sodium carbonate from leach liquors formed in processing ores of tungsten, molybdenum, uranium, vanadium, and related metals, the liquor is cooled to the optimum temperature at which sodium carbonate decahydrate is crystallized out in substantially pure form. The precipitate is then separated from the liquor for reuse in leaching additional ore. R. L. Pilloton, assigned to Union Carbide Corp. U.S. 2,963,363.

Apparatus for separation of solids from slurries without filtering, and then washing and classifying the solids, which is particularly applicable to the separation of alumina trihydrate from solutions produced in the Bayer process for recovering alumina from bauxite. H. Loevenstein, C. W. Carlson and L. B. Gunderson, assigned to Harvey Machine Co., Inc. U.S. 2,964,179.

Mr. North is patent consultant, Washington, D.C.

Method for leaching low-grade uranium-vanadium ores whereby the values are concentrated in a small volume of the leach solution. The first portion of the solvent is not treated to extract the metals; instead, only an optimum amount of the later pregnant effluent is so treated. M. Kolodney and S. C. Hyman, assigned to Nuclear Development Corp. of America. U.S. 2,964,380.

Method for processing high-iron bauxites or other aluminum-bearing materials to recover a relatively low-iron sodium aluminate solution, suitable for metallurgical use, and a high-iron concentrate useful in the production of steel, in powder metallurgy, etc. Soda ash and calcium carbonate are mixed with the ore, and the mixture is calcined at a temperature below the fusion point of metallic iron, whereby the iron concentrate is recovered in powder rather than molten form. J. Kamlet, assigned to Reynolds Metals Co. U.S. 2,964,383.

Improved centrifugal screening apparatus for making multiple separations of suspended mineral particles by density differences. Separation of the various fractions of a nickel-copper-iron ore is cited. Z. Vane. U.S. 2,965,232.

Apparatus for controlling discharge of ore, ore fines, coke, and other ingredients into an iron-ore sintering apparatus, whereby a predetermined proportioning is maintained. T. R. Schuerger and F. Slamar, assigned to U.S. Steel Corp. U.S. 2,965,265.

Copies of U. S. patents can be purchased at 25c each from Commissioner of Patents, Washington 25, D. C.

Control means for use in taconite ore-beneficiation plants to maintain the density and quantity of pulp at a desired level, and to stabilize the circulating load on the ball mill. The quantity of crude ore fed to the ball mill is regulated depending on the magnetic iron content of the pulp. A. S. Henderson and E. W. Davis, assigned to Reserve Mining Co. U.S. 2,965,316.

Design for an improved apparatus for breaking hot iron-ore sinter cake into chunks and pieces of desired maximum size. V. F. Koontz, assigned to Dravo Corp. U.S. 2,965,321.

BRITISH PATENTS

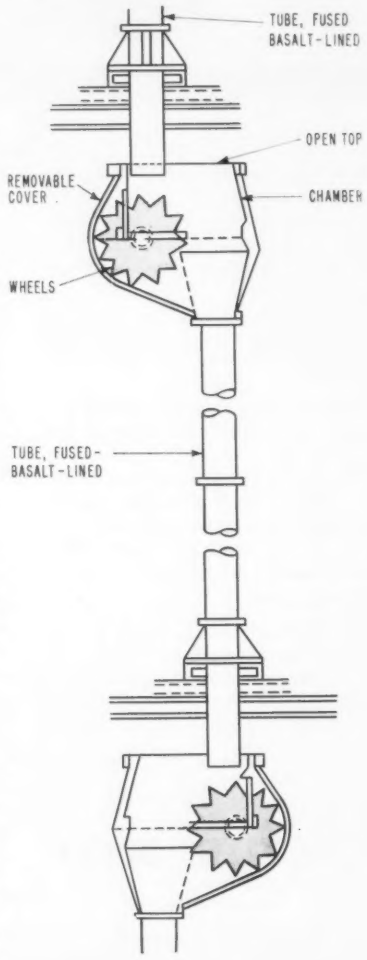
Exploration

An electromagnetic system for aerial exploration for subsurface ore bodies consists of a source of alternating current, two transmitting coils disposed at right angles to each other, two receiving coils disposed at right angles to each other, and means for measuring and recording the difference between the signals induced in the two receiving coils at corresponding operative intervals. Weak signals or error signals can be eliminated. Assigned to Canadian Airborne Geophysics Ltd. Sept. 14, 1960. British 848,428.

Mining

Design for an improved apparatus for charging a skip of a mine-shaft winding installation, wherein the measurement of the useful load of the skip is combined according to both volume and weight. Thus, if the skip-charging bin is loaded with a predetermined volume but is still below a predetermined weight, the weighing means can cause additional material to be fed into the bin. Assigned to Skip Compagnie G.m.b.H. Sept. 28, 1960. British 849,681.

In an improved cascade chute installation for use in backfilling mined-out portions of an underground mine with rock, mill waste or the like, a section of chute, lined with fused basalt, terminates in a chamber open at the top and provided with a number of side-by-side, shaft-mounted, non-power-driven, freely-rotatable wheels (see illustration).



How many "machines" is a MODERN LOADER?

JOB-PROVE the 4-in-1 and see...

Here's what the 5 Four-in-One's, shown, are doing: (1) (Left foreground) The 3-cu. yd. TD-20 rig is 'dozing; (2) (Right foreground) The ¾-cu. yd. T-340 outfit as "carry-type scraper;" (3) (Right center) The 1⅛-yd. TD-6 4-in-1 "semi-skids" load on its skid shoes; (4) (Center): This 2¼-cu. yd. TD-15 "biting bucket" clam-handles a stump; (5) (Rear) TD-9 rig is back-dragging gravel!

It's a whole equipment spread of job-getting actions, if it's "the bucket with the bite"—an exclusive clam-action International Drott 4-in-1.

"Dragonized" to dramatize "the bucket with the bite," the five 4-in-1 sizes above demonstrate *plus* actions you get with the exclusive clamshell.

Full-capacity, full-range, depth-controlled bull-dozer performance. "Carry-type scraper" action to grade, strip, or spread with inch-close accuracy. Skid-Shovel action to "semi-skid" full buckets of material. Controlled back-dragging clam-action, to grade, pick up, or pull down materials. "Clamming-on" action to grab and load heavy unwieldy "impossibles."

Note also the 4-in-1 gives you the top excavator-loader performance on the market! That includes certified break-out forces ranging from 11,200 lbs. with the T-340, to 43,150 lbs. with the TD-20. And only the 4-in-1 gives you clam-type bottom dumping—that ends sticky materials loading problems, for good!

See for yourself how many "machines" the only *modern* loader is! Move the 4-in-1 machine-action selector lever. Prove you get a whole spread of money-making actions, that obsolete "single-action" loaders, and double for a yard-full of limited-duty rigs! See your International Drott Distributor for a 4-in-1 demonstration.

International Harvester Company, Chicago 1, Illinois
Drott Manufacturing Corp., Milwaukee 15, Wisconsin

INTERNATIONAL HARVESTER

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British Patents (*Cont.*)

These are positioned so as to interrupt the fall of material from an upper chute section and then feed it to the next-lower chute section. The fill material is both slowed and broken by impact against the wheels. This lessens wear on chute linings and produces a bulk fill composed of smaller pieces more suitable for packing old mine openings. B. Furmanek, J. Holesovsky and W. Wittich. Nov. 30, 1960. British 855,105.

In an improved apparatus for charging ore skips in mines, the charging bin can be tilted upward from an initially horizontal position into an angle at least slightly greater than the angle of repose of the material being handled. K. Trompke, assigned to Skip Compagnie G.m.b.H. Oct. 26, 1960. British 852,476.

Metal and Mineral Processing

In fluidized-bed roasting of sulphide ore concentrates, cooled product gas from the roasting operation is locally blown downwards upon the surface of the fluidized bed to promote settling of small particles suspended in the main upward gas stream. Assigned to Chemiebau Dr. A. Zieren G.m.b.H. Sept. 14, 1960. British 847,623.

Design for an improved sink-float separation apparatus for concentrating very finely divided ores. Two or more separating chambers are connected in series, and float from the first chamber is reprocessed in subsequent chambers, thus giving fine mineral particles additional opportunity to sink, even though they were occluded in the first float fraction. Assigned to Klockner-Humboldt-Deutz A.G. Sept. 14, 1960. British 847,879.

Apparatus for classifying asbestos fiber wherein the separation is made by subjecting the crude fiber to the opposed forces of fluid flow and centrifugal forces. The lighter particles are drawn inward out of the spiral stream of fiber, while heavier particles remain in the stream. Assigned to Quebec Dept. of Mines. Sept. 14, 1960. British 848,164.

To recover aluminum, iron and titanium values from "red mud" obtained in bauxite processing, the mud is sintered with sodium carbonate and sodium borate, and the sinter product is washed with boiling water. Iron and titanium solids are separated from an alkaline solution of aluminum- and other metal oxides. The solids are smelted. The solution is decomposed with carbon dioxide to precipitate aluminum. Assigned to Soc. des Blancs de Zinc de la Mediterranee Eng. Chabaury-Pierre Gindry & Cie. Sept. 14, 1960. British 848,230.

Anion exchange method for treating aqueous cyanide solutions in which gold, silver, cobalt, nickel, or platinum-group metals are complexed along with iron and/or copper, whereby the proportion of iron and/or copper adsorbed by the resin can be considerably reduced. A nitrogenous anion exchange resin having both strongly and weakly basic exchange groups is used. J. Aveston, D. A. Everest and R. A. Wells, assigned to National Research Development Corp. Sept. 21, 1960. British 848,555.

Method for processing garnierite, and like hydrated silicate ores of nickel and magnesium, to yield water-soluble salts of nickel and magnesium. The ore is reacted with sulphur trioxide at 600-750°C, in the absence of any other compound reactive under the conditions of the reaction. The resulting metal sulphate compounds are separately recovered. Sulphur trioxide can advantageously be derived continuously from roasting of pyrites. This process can also be applied to pollucite, ores of columbium-tantalum, and others. M. Archambault, C. A. Olivier and J. U. M. MacEwan, assigned to Quebec Dept. of Mines. Sept. 28, 1960. British 849,364.

Calcium oxide or barium oxide is mixed with the ore-fuel charge in the hydrogen reduction of iron oxide ores. This charge produces so much heat that the reaction becomes exothermic. Reduction absorption temperatures are within the range 500-550°C, and pressure is about 11 atmospheres J. O. Edstrom and U. O. H. Wiberg. Oct. 12, 1960. British 851,296.

Copies of British patents can be obtained from the Patent Office, 25 Southampton Bldgs., London, W. C. 2, England.

Design for an improved ore briquetting press for use at very high pressure. Each roller wheel has fastened to its circumference exchangeable ring segments, having gaps between adjacent segments so positioned as to cooperate with segment gaps of the opposing roller wheel, so as to form rhomboidal briquettes. Assigned to Klockner-Humboldt-Deutz A.G. Oct. 19, 1960. British 851,664.

Apparatus for and method of continuously tapping molten slag and molten lead separately from the bottom of a lead blast furnace. The two materials are continuously drawn into a side chamber, or tapping bay, and withdrawn therefrom. J. T. Roy, assigned to American Smelting & Refining Co. Oct. 26, 1960. British 852,441.

Method of treating arsenopyrite ore to produce a material which, by leaching, can be dearsenified enough to be suitable for ferrometallurgical purposes. Before or during roasting, the ore is sprinkled with any one of several listed compounds of calcium, sodium, magnesium or potassium. It is then leached with sulphuric acid to remove soluble arsenic compounds. Assigned to Instituto Nacional de Industria. Nov. 9, 1960. British 853,741.

Fine material is fed through an electrical current passing from one carbon roll to another, in the continuous sintering of iron oxide ore or other metal ore concentrates or fines. The electrical heating agglomerates the ore into lumps. Lump size can be increased by widening the roll gap and increasing the current and the volume of ore feed. Assigned to Klockner-Huttenwerk Haspe A.G. Nov. 23, 1960. British 854,729.

CANADIAN PATENTS

Metal and Mineral Processing

In the elimination of iron chlorides from titanium ore chlorination slurries, the slurry is fed into a bed of sand, gravel, or like particulate solids, which has been preheated to a high enough temperature to vaporize titanium tetrachloride but not high enough to vaporize iron chlorides. The vapor is collected and condensed. This method is also applicable to the chlorination of ores of zirconium, tin, and aluminum. A. C. Ellsworth, assigned to Columbia-Southern Chemical Corp. Nov. 29, 1960. Canadian 609,677.

In a process for extracting a high percentage of the nickel and cobalt content of low-magnesia, high-iron lateritic nickel ores, the ore is treated with gas at elevated temperature to selectively reduce nickel, cobalt, and part of the iron. The reduced ore is subjected to three-stage, relatively low-temperature gaseous treatment, followed by water leaching. High-purity nickel and cobalt, and an iron-rich residue suitable for steel production, are obtained. A. Illis and P. E. Queneau, assigned to International Nickel Co. of Canada, Ltd. Dec. 6, 1960. Canadian 610,166.

In the recovery of values from phosphate ores, fluorspar, feldspar, sylvinite, langbeinite, and like nonmetallic ores, an aqueous suspension of ore is conditioned with a reagent formed by the hydrolysis reaction of sodium hydroxide with either tall-oil pitch or soya-oil pitch; and the conditioned pulp is subjected to froth flotation, tabling, or spiral concentration methods. I. Sollin, assigned to International Minerals & Chemical Corp. Dec. 6, 1960. Canadian 610,191.

Copies of Canadian patents can be obtained from Commissioner of Patents, Patent & Copyright Office, No. 8 Bldg., Carling Ave., Ottawa.

Apparatus and process for smelting iron oxide ore or other metal-oxide ores or concentrates in a cyclone combustor. Coal high in impurities can be used as the fuel. The ore-flux-coal mixture is first subjected to a helically swirling stream of neutral or slightly oxidizing gases; then the resulting mixture of slag, partially reduced ore, and carbon is treated with a swirling stream of a reducing gas to complete the reduction. H. P. Hudson, assigned to Canadian Dept. of Mines & Technical Surveys. Dec. 13, 1960. Canadian 610, 309.

CYANAMID

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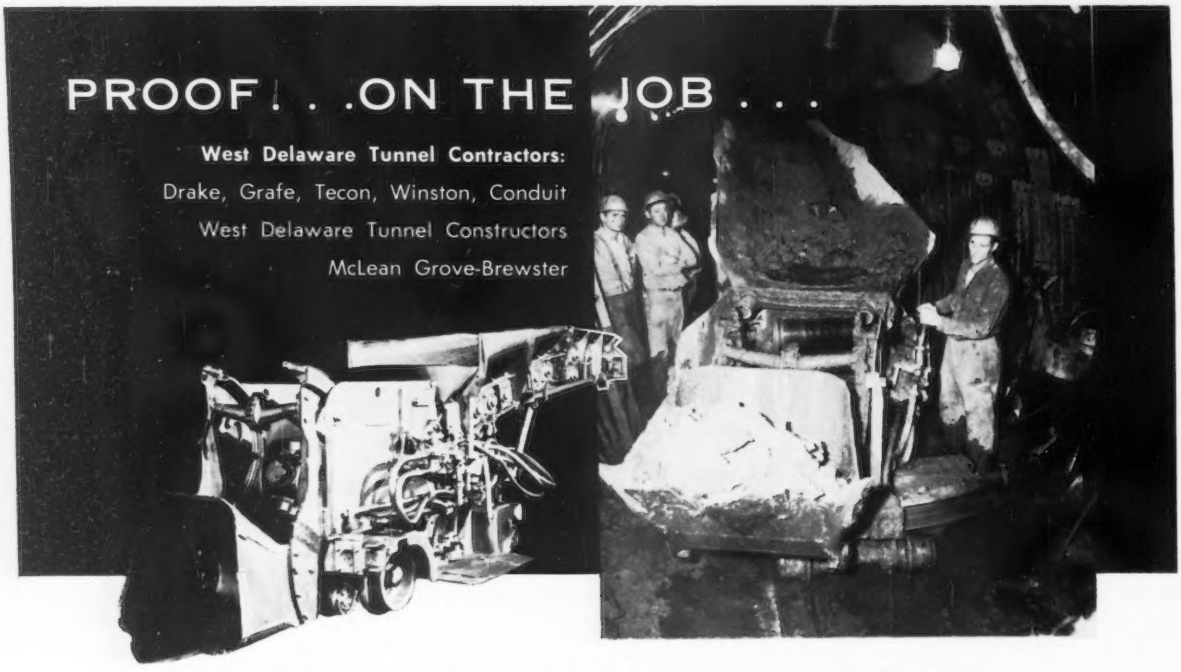

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A MESSAGE TO AMERICAN INDUSTRY • ONE OF A SERIES

By our method of reporting unemployment...

We're Giving The United States A Black Eye That Is Not Deserved

The way in which our unemployment is reported is giving the United States an undeserved black eye around the world. The broad concept of unemployment we use exaggerates the amount of unemployment in the United States as compared to most other countries. Our reporting system also falls short of presenting a balanced picture by concentrating on people who are idle, while neglecting jobs that are idle because people cannot be found to fill them. This editorial explains these defects and suggests improvements.

The *Monthly Bulletin of Statistics,* issued by the Statistical Office of the United Nations, has become a standard reference for international comparisons of economic performance, including employment and unemployment. Here, from the November, 1960 issue, is part of a table giving comparative figures on the rate of unemployment for the United States and a group of European countries:

	UNEMPLOYMENT RATE	
	Annual Average 1959	Jan.-June Average 1960
West Germany	2.4%	1.0%
Netherlands	1.8	1.4
Sweden	2.0	1.8
United Kingdom	2.3	1.9
United States	5.5	6.1

A Distorted Picture

If taken at face value the table clearly says that the United States is doing far worse in providing jobs for its citizens than the other countries whose unemployment records are listed.

But the figures are deceptive. They are made so, in part, by our government's use of a much broader concept of what constitutes unemployment than is used by most other countries.

Sweden provides a clear case in point. The table indicates that during 1959 Sweden had an unemployment rate of 2.0%, while the rate in the

United States was 5.5%. But a report from Sweden, published in the U.S. Department of Labor's *Labor Developments Abroad,* indicates that if they had used the same methods of calculating unemployment as we, the reported jobless rate in Sweden would have almost doubled. Thus a large portion of the gap between the unemployment rate in the United States and the unemployment rate in Sweden would have been eliminated.

Graduation To Unemployment

In general, countries listed in the table use registrations at public employment agencies as the basis for calculating their unemployment. Our Department of Labor, in making its sampling of unemployment, includes unregistered young people who are waiting for jobs or training opportunities as well as housewives who are looking for jobs in a general sort of way but who have not registered anywhere in search of them.

It used to be that graduation from college was regarded as a day for great celebration and rejoicing. But, because of the way the Labor Department does its counting of unemployment, it is now a day of sorrow. For unless our young people immediately rush off to jobs, they graduate into unemployment and swell our jobless figures.

While our government very expansively counts all the unemployed, there is no offsetting report on the number of jobs that are unfilled because no one qualified can be found to fill them. Currently there are many jobs in this category, and it is to be expected that there will be more as the technological revolution picks up momentum.

A properly balanced report on unemployment would include a record both of people who are idle, as conceived on some standard international basis, and jobs that are idle. A combination of the two sets of data would provide a much better indication of the economic health of a nation than unemployment alone.

The United Kingdom regularly collects figures on unfilled jobs as well as the number of unemployed. Thus it is not an impossible task to collect information on idle jobs. **For a fast moving economy, such as ours, the collection of statistics on unfilled jobs presents special difficulties. But this information is so important that Congress should see that it is added to our employment and unemployment records.**

A National Disservice

There is not the slightest inclination here to minimize the amount of unemployment in the United States at any time, or the crucial importance of doing everything possible to keep it at rock bottom. If the reporting of unemployment were simply for domestic consumption, it would be possible to make an appealing case for using a very broad conception of it. This is one way of underlining the importance of the problem.

But when, as is the case, international comparisons of unemployment are treated as key gauges of the effectiveness of different economies, we do ourselves an important national disservice by using an exceptionally commodious concept of unemployment. American travelers abroad can testify that they are continuously being called upon to explain why the United States does such a relatively poor job in providing employment for its people. This is an unwise and unfair burden to impose upon the nation. **We make enough mistakes of economic commission and omission without issuing reports that distort our economic performance to our own discredit abroad.**

This message was prepared by my staff associates as part of our company-wide effort to report on major new developments in American business and industry. Permission is freely extended to newspapers, groups or individuals to quote or reprint all or part of the text.

Donald C. McGraw

PRESIDENT

McGRAW-HILL PUBLISHING COMPANY

CREWS of the Grants Pipe & Tank Co. fabricated the 72-in. casing for the ventilation shaft from ¼-in. steel plate. Shaft bottomed out at 710 ft.

Kerr-McGee Sinks Cased Ventilation Shaft

DRILL CREWS of Kerr McGee's rotary rig No. 7 in the Ambrosia Lake area near Grants, N.M., have dismantled the rig after finishing installation of 72-inch casing in the 90-inch experimental ventilation hole at Kermac Nuclear Fuels Corp.'s Sec. 24 mine. The hole was bottomed at 710 ft Dec. 31, 1960. The first 32 ft joint of casing was lowered into the hole early Saturday by the derrick crew and welders of Grants Pipe & Tank Co.—fabricator of the ventilation pipe—who worked around the clock to complete the job.

The rig was set up 47 days prior to completion of the casing operation.

A concrete pad was poured around the collar at the surface in preparation for the installation of two 125-hp Joy Axivane fans in a V-pattern over the hole. The combination of large-diameter hole and ventilation fans positioned in this manner will allow the circulation of more than 100,000 cu ft of air per minute in the mine.

Work on the development drive in the Sec. 24 mine was halted approximately 85 ft from the shaft pending its completion. Work will resume soon to drive the development tunnel beneath the ventilation hole.

The big rig — Kerr-McGee's Rotary Rig No. 7—was moved into the area from Lamesa, Tex. Its mast stands 133 ft above ground level and the rig is powered by two 325-hp Waukesha engines. An Allen-Sherman-Hoff pump, powered by a 250-hp Cummins diesel engine, pumps 8000 gpm of mud through a 12-in. line.

The drill bit—cone-shaped and weighing 17,000 lbs—was specially designed and constructed by Hugh B. Williams Co. It has a 90-in. base from which are mounted 28 separate rolling cutter bits, and uses three lead-filled, steel-jacketed collars weighing 42,000 lb each. Diameter of the drill stem is 13⅜ in. and total weight of the bit assembly is 147,000 lb. It rotates at about 10 to 14 revolution per minute.

Marion Bolton is general manager of Kermac Nuclear Fuels Corp., and R. K. Pertile is Kermac engineer. Jim Bawcom is project engineer for Kerr-McGee Oil Industries, Inc.

Cerro de Pasco Offers $7,600 in School Grants

GRANTS TOTALING $7,600 were presented by Robert Koenig, president of Cerro de Pasco Corporation to four colleges and universities as part of a long-range company program of aiding higher education.

The schools and the amount each received are: Colorado School of Mines, $3600; Montana School of Mines, $2500; University of Idaho, $1000; and the University of Illinois, $500. Cerro chose these schools "because of their fine cooperation in giving selected Peruvian engineers post-graduate training in the U.S." Cerro, whose principal mining interests are in Peru, had granted scholarships to eleven Peruvian mining engineers, who studied at these schools.

Vitro Gets All Pechiney Rare Earth Patents

VITRO CORPORATION OF AMERICA has purchased all minority interest in its chemical subsidiary held by Pechiney, French industrial chemical leader. Vitro has also entered into a new royalty agreement to run until 1974. This gives Vitro exclusive rights to Pechiney process and product patents involving rare earth chemicals, metals, alloys and related compounds. Vitro, which produces inorganic chemical products for industry and uranium concentrates for the Atomic Energy Commission will exchange know-how with Pechiney in the field, and in related products of thorium, scandium, yttrium, hafnium and zirconium compounds.

Copper Research Group to Study Smog; New Cu Uses

THE COPPER PRODUCTS Development Association has approved research proposals in excess of $132,000 as the initial phase of its 1961 program. Organizations which will receive research contracts are: Armour Research Foundation, Chicago; Applied Research Laboratory, University of Arizona, Tucson; Battelle Memorial Institute, Columbus, Ohio; Franklin Institute Laboratories, Philadelphia; Fulmer Research Institute, England; and Stanford Research Institute, Palo Alto, Calif.

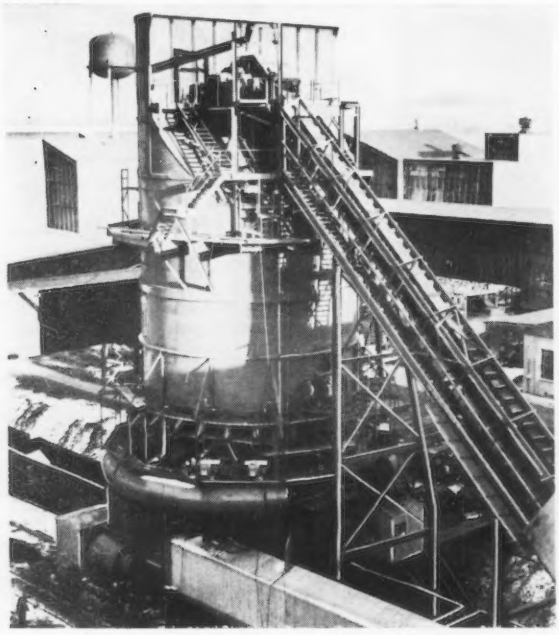
Studies will seek technical information on copper and its alloys and compounds for development of new and improved copper products. Areas to be investigated are: catalytic action of copper in internal combustion engines, oxidation of copper, using the field emission microscope to investigate reaction phenomena, new uses for copper in electrical industry, effects of copper on corrosion resistance of pearlitic cast iron by sulfuric acid, and the feasibility of anodic treatment of copper alloys.

Two studies related to smog will concern copper-containing catalysts for automobile afterburners, and the use of copper-containing organometallics as fuel additives.

Gulf States Buys W&K Huge Steel Slag-Pile

WEBB & KNAPP, INC., has turned its project to make steel from Anaconda Co.'s 40-million ton slag-pile over to Gulf States Land & Industries, Inc.

Gulf States will receive from Webb & Knapp a contract to purchase slag from the Anaconda slag pile and all future production from its smelter at 25c per ton. Gulf States will acquire all other Webb & Knapp agreements with Anaconda as to site, auxiliary facilities and a steel mill which is tentatively to be built near the smelter later this year.



J&L Installs New Sinter-Cooler

A NEW sinter cooler—first of its type—has gone into operation at the New York Ore Division of Jones & Laughlin Steel Corp. The new equipment, designed and installed on the Division's Sinter Plant by Dravo Corp., Neville Island, Pa., differs from the conventional-type rotating cooler in that it is stationary. The sinter, cooled by blasts of air as it works down through a vertical shaft, is exposed for 1½ hours, as compared to 15 to 20 minutes in a circular cooler.

The cooler, with a rated capacity of 3800 tons is approximately 100 ft high, has a diameter of 44 ft at its widest point and is shaped like a blast furnace. Installed also are new breaking and screening facilities for the division's two 6-ft wide sinter machines. Fused sinter leaves the two machines, is discharged onto an apron feeder which carries it to a new Dravo-Lurgi breaker. It then passes through a new Dravo-Schenck vibrating screen which removes the hot fines or small articles. It is then delivered to the cooler, and is removed from the discharge end by a combination fender-screen to railroad cars.

Electric-Oxygen Method May Be Used on Oil Sands

FIELD experiments are being conducted at St. Paul, Kans. by a research arm of the Kewanee Oil Co., to loosen the oil from Athabasca tar sands.

Electrodes are dropped down shafts more than 100 ft apart; more than 3000 v of electriity are then shot across the gap. By sending oxygen through this area, combustion occurs and gases are formed that force oil to the surface. Portable generators are used, or high voltage lines may be tapped. This same technique may be applied to coal with the resultant production of gas that may be used for commercial purposes.

The firm states that its knowledge in the fields of underground gasification has advanced sufficiently and its equipment is adequate to undertake research and development projects for government or industry on a contract or consulting basis.

Iron Production Starts At New B. C. Plant

BY PUTTING into production its new electric-furnace iron plant at Kimberley, B.C., last month, Consolidated Mining & Smelting Co. of Canada has taken a step toward full utilization of the complex ores of its Sullivan mine, and has opened the first plant in western Canada to make iron from western Canadian ore.

Sullivan has long been a major lead and zinc producer. Since 1953 the iron sulphide minerals in the ore have been roasted to give SO_2 to make sulphuric acid for Cominco's fertilizer plant at Kimberley. Now the iron-oxide calcines from roasting are feed for the iron-smelting plant.

Output of the iron plant will be gradually raised to its full capacity of 100 tpd. It is the first unit in an integrated iron-and-steel operation, eventually to turn out 300 tpd of pig iron, steel ingots, and basic steel products. Total cost will exceed $20-million; cost of the iron plant alone, including the electric furnace and the sinter plant, has been $7.5-million.

An important reason for locating the plant at Kimberley was the availability of power from Cominco's hydroelectric plants in the West Kootenay district. New equipment was installed in the Sullivan concentrator to yield a cleaned iron concentrate. The iron oxide calcines are pelletized and sintered with coke; then sinter, coke and limestone flux are charged to the electric furnace. Over 15 million tons of iron have been accumulated in stockpiled concentrates, and new production yields over 350,000 tpy.

Iron will be marketed in Canada, through Cominco's Vancouver office, and in the U.S., by Associated Metals & Minerals Corp.

IN THE U.S.

CALIFORNIA

Total value of California minerals in 1960 was approximately $1,410,743,000 —representing a drop of $13.4-million from the 1959 total. This is the smallest drop in mineral values noted since the peak year of 1956, and may represent a levelling off of the mining decline in this state.

A slump in the construction industry was blamed for a decline of approximately $22-million in the value of nonmetallic minerals from their high of $400-million in 1959. Tonnages of gypsum, cement, sand and gravel declined; the ratio of non-metallic minerals to over-all mining activity consequently declined to 26.9% from the 1959 high of 28.1%. This was the first such decline in non-metallic minerals since 1952.

In metals, there was a continuation of the decline that started in 1957. There was no activity in chromite or manganese. Molybdenum production declined following the end of selective mining at Pine Creek mine in Inyo county; however, tungsten production rose "appreciably" above 1959 levels on completion of an ammonium paratungstate plant in Inyo county early in the year.

Copper production rose slightly from 663 short tons in 1959 to 680, but did not reach the 749-ton level of 1958. Zinc increased sharply from 78 tons in 1959 to 250 tons. Primary cause was reactivation of the Copper Bluff mine in Humboldt county. Another cause of increased zinc tonnage was an increase of activity at the Santa Rosa mine in Inyo county. Lead-zinc ores from this mine also contributed greatly to the increase in lead, from 78 tons in 1959 to 250 tons in 1960.

Although not shown in the accompanying chart, USBM reports substantially higher values in rare-earth shipments, reflecting increased in experimental uses in industry of "exotic" metals. Uranium shipments, however, remained unchanged from 1959.

In 1960 the Bureau of Mines completed reconnaissance of a beryllium deposit near Lone Pine, in Inyo country, which is now being drilled intensively under option by a Nevada mining firm. In con-

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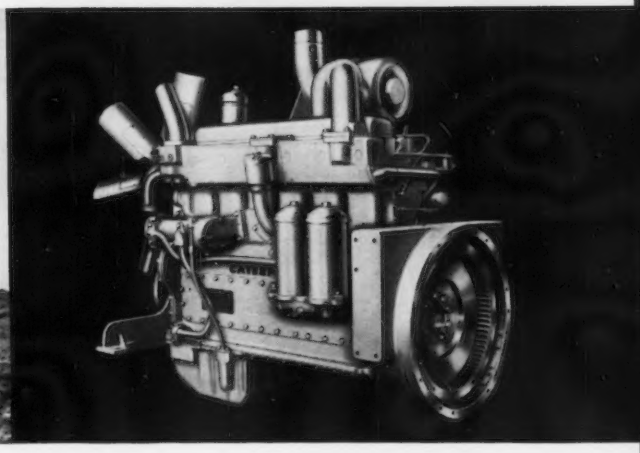

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NEW STARTING ENGINE All-weather starting with this new two-cylinder vertical gasoline engine is assured. Replacing the horizontal engine, this design features aluminum pistons and overhead valves for improved performance. Bore is 2.38″, stroke is 2.38″, and compression ratio is 8:1. Over-running clutch in starter pinion prevents damage to starter engine when diesel starts, a year-round starting plus.

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California (*Continued*)

junction with Calif. Division of Mines, USBM is reconnoitering and sampling two nickeliferous laterite areas in northern California and is working on two major recovery projects. One is for recovery of tungsten from scheelite ores; the other the recovery of alumina from a large deposit of anorthosite in southern California. Estimated mine production for 1960 and 1959 follows: (in short tons)

	1960	1959
Barite	**16,700**	28,143
Boron minerals	**617,900**	619,946
Cement (mill bbls)	**39.6**	43.6
Copper	**680**	663
Gold (troy oz)	**122,200**	146,141
Gypsum	**1,648,000**	1,686,000
Lead	**340**	227
Mercury (flasks)	**18,200**	17,100
Silver (oz)	**134,000**	173,000
Zinc	**250**	78

COLORADO

Metallic mineral production during 1960 closely paralleled the previous year, except for a decline in zinc.

G. A. Franz Jr., deputy commissioner of mines, said preliminary figures showed the same metallic leaders as in 1959. Uranium is the leader with 1960 production valued at nearly $50-million. Molybdenum production approximated $45-million and vanadium hit close to $12-million. All three leaders, pending a final compilation, were within a few hundred thousand dollars of 1959's valuation Franz said.

Total metallic mineral production for the state is expected to reach $130-million. The 1959 total was $130,695,200.

Zinc production will be down from 1959's $8,269,752 because of a strike at state zinc plants but some gains in precious metals will offset that drop.

Other principal metallic minerals produced in 1960 and the approximate valuation of production were: tungsten $3-million, lead $3-million, gold $2-million, copper $1.6-million, pyrite $1.3-million and silver $1-million. Those were the only metals topping $1-million in 1960.

Franz said the failure of the state's metallic mineral production to advance in 1960 over 1959 was partly because of the low fixed price on gold and silver that retarded base and previous metal production and foreign competitive prices on copper, lead and zinc.

Colorado Bureau of Mines has ordered the operators of the state's 300 uranium mines to establish ventilation procedures that will limit the concentration of radon to 300 micro micro curies per liter of air.

The order follows a conference in Denver Dec. 16 of representatives of the U.S. Public Health Service, the Colorado Health Department and officials of uranium producing states. At this meeting the U.S. health agency gave the first report on results of the physical examinations of uranium miners.

"The results of the 1960 examinations were alarming and a cause of great concern, said G. A. Franz.

Franz said the report showed that 3.3% of the miners examined showed positive cancer cells in lung fluids. Of that number, 16% "had positive indications that these cells were developing." He added that this was the first report showing uranium miners are more susceptible than others to lung cancer.

Standard Metals Corp. has intersected what may be an important new ore body at its Sunnyside mine in the Silverton district of southwestern Colorado.

Charles Steen, vice president of exploration for the Moab Utah-based company said that in extending and rehabilitating the American tunnel, core drills intersected two veins of lead-silver-zinc-gold ore mineralization. Steen believes gross value of the ore in the veins is approximately $19.50 a ton and would produce net smelter returns of $12 to $13 per ton. One vein is ten feet wide, the other, five. The discovery is 320 ft below any known mineralization at Sunnyside. It is not an apparent extension of existing fissures. Geological indications are, he believes, that the veins could strike along a 2600 ft distance. In cutting the veins, water pressure of 450 psi pushed core drill and drilling assembly back 150 ft in the tunnel. The American tunnel is being rehabilitated and extended in order to provide drainage for the ore area in the old Washington shaft and from other workings in the area. Standard has expended some $1.5-million in this effort, and it was a "good geologic bet" that new ore would be found in the process, Steen stated. If true, it will be immediately developed and mined.

FLORIDA

Mineral production reached an all time high in 1960 with a total estimated value of $168-million, according to USBM's survey. For the sixty-seventh consecutive year, Florida led the nation in production of phosphate rock.

Titanium ore production, principally ilmenite and rutile, was increased 9% over 1959, but the value remained the same.

Apex Mineral Corp. of Franklin, N. C. and Winter Haven, Fla., has announced plans to build a modern vermiculite processing plant in the Orlando area sometime during the coming year.

Roy F. H. Fouts of Franklin, secretary of the company, a new firm incorporated last September, said that a plant for a scrap mica recovery plant also will be built at Franklin. He said the plant in Orlando will be fully automatic.

IDAHO

The preliminary report of USBM for 1960 shows the value of mineral production declined $14.4-million from 1959. The Bureau said the drop from $70.2-million in 1959 to $55.8-million in 1960 resulted mainly from strikes that closed lead-zinc operations of the Bunker Hill Co. and the American Smelting & Refining Co. from May to December, the permanent closure of the Calera Mining Co.'s cobalt mine in Lemhi County, and

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Exclusive HYDRAULIC OPERATION

. . . designed for low installation, operation and maintenance costs. Fixed or variable feeding rates are easily available. Length of stroke can be varied from 6 to 24 inches.

MINIMUM HEAD ROOM . . . requirements are as little as 20 inches and construction costs reduced. Impact damage to unit being loaded is minimized . . . discharge drop only 6 to 8 inches.

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designed for vibrators or stationary applications —for dewatering, screening, washing, extracting, filtering or sizing

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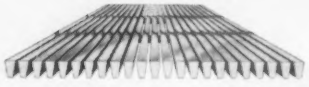
A new concept in guard bar design. T-shaped wire replaces typical "bar" to increase screening surface while keeping large unscreenable lumps of material above the tolerance governing lower screening surface.

F217 and F250
KLEENSLOT

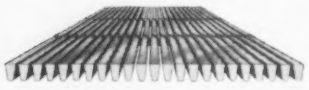


Large size wires maintain maximum efficiency over an extended period in abrasive applications.
Although large in wire size, this screen will maintain openings as close as 1 m.m.

"S" KLEENSLOT

For applications where screening out of flats or slivers is of prime consideration. Also furnished in a "C" bend. Recommended for applications requiring openings larger than 1 m.m.

MARCEL



This screen, while screening out "slivers," presents a flat surface for materials to wipe the opening clean Available with openings up to 1 m.m.—for larger opening see "S" screens.

SCREEN GUARD

Vertical guard bars keep larger unscreenable materials above the actual screening surface. This increases screen life and promotes much greater efficiency in dewatering.

G187 and GB187
MIGH-TEE KLEENSLOT

Special profile increases wearing surface. This is a heavy duty precision type screen that will easily maintain openings smaller than 1/8 m.m. and openings larger than ordinarily considered economical.

TAPER-SLOT

From loop to loop, the screen opening gradually increases. This design is to eliminate blinding when screening large amounts of near-opening size materials. For example: .016 opening tapered to .024—the combination of opening sizes would be the same between each loop throughout the entire screen.

Wedge-Wire Kleenslot Screens are custom manufactured to your application and are available in many sizes, metals and finishes. Our engineering staff will assist you capably and promptly in obtaining the proper screen for highest production at lowest cost.

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SCREENS FOR INDUSTRY

Idaho (*Continued*)

lower production of all nonmetals except rock.

Idaho County continued as the source of most placer gold recovered during 1959. As in 1958, the Gold Bar placer was Idaho County's largest placer gold producer, but production was substantially below 1958.

USBM figures showed a $4.8-million drop in lead production, a $3.2-million drop in zinc production, a $3.3-million drop in silver production and a $2.8-million drop in copper production. Cobalt production was down to zero compared with 1.1-million pounds produced in 1959. Gold output dropped 46% to 5619 oz due largely to the closure of the Blackbird mine in central Idaho operated by Calera Mining Co.

Silver output was 13,040,000 oz, down 22%; lead was 41,075 tons, down 34%; zinc was 37,237 tons, down 33%. Copper output was off 53% to 4060 tons.

Golconda Lead Mines, Wallace, Idaho, reported net income of $63,297 for the first nine months of 1960. The firm's milling operations have been suspended since February 1960, and the principal source of income for the company has been dividends on 155,000 shares of stock in Lucky Friday Silver-Lead Mines Co., Wallace, Golconda also has 36,000 shares of Hecla Mining Co., which has a controlling interest in Lucky Friday.

Production from the Silver Summit operations of the Hecla Mining Co. near Wallace totaled 18,451 tons of ore assaying 31.60 oz of silver per ton during the third quarter of 1960, L. J. Randall, president, reports. He said also that Hecla's share of production from the Unit Area, in the same section, was 52,856 tons assaying 25.80 oz of silver. The Unit Area is operated for Hecla by Sunshine Mining.

The Lincoln Mining Co.'s royalty from operations of the Rotbart section of its mine by Sunshine Mining Co. totaled $83,476 in the first 10 months of 1960, C. J. Hamilton, Coeur d' Alene, advised stockholders. He said Sunshine is proceeding with the sinking of a shaft another 300 ft below its present 4000 level which may result in further development of the Rotbart area at depth.

Idaho Mining & Milling Inc. announced that it has acquired a third dredge, a 2½-cu ft Yuba, bucket line, floating plant, with gross weight of more than 300 tons.

The company plans to move all three dredges into the Florence basin, where it owns more than 40 miles of streambed. Gold dredging operations are scheduled to start later this year.

Since its incorporation in 1958 Idaho Mining & Milling has purchased two other dredges, a 2 cu ft Yuba bucket line with gross weight of 250 tons, and a Bodinson wash plant, dragline-fed. Three dredges have total capacity of 6500 cu yd of gold bearing gravel daily.

Idaho Mining & Milling is owned by Philip, Clyde and Marion Jungert and Anton Backus.

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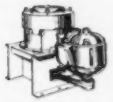

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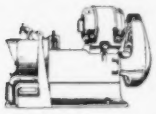

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OFFICES AND AGENTS IN PRINCIPAL CITIES

Idaho (*Continued*)

The Index-Daley Mines Co., of Salt Lake City, Utah has announced plans to resume work at its property in the Hailey, Idaho, area. Charles S. Woodward of Salt Lake City is president of Index-Daley.

The Engineers council for Professional Development has granted full accreditation for all engineering departments at the University of Idaho in Moscow, President D. R. Theophilus of the University has announced.

Coeur d' Alene Mines Corp. of Wallace will diamond drill from the Mines' 1000 ft. level to test a wire silver vein at horizons where it had not been previously explored. Dr. H. C. Mowery of Wallace heads the company.

Idaho Mining and Smelting Co. of Weiser has filed 13 millsite claims in the Heath mining district of Washington county.

Sunshine Mining Co., Spokane, reported operations at the Sunshine mine near Kellogg, continued in 1960 at about the same production pace as 1959. The 1960 projected production figures (actual production for 11 months plus the average for one month) include 232,271 tons of ore milled which produced 6,095,520 oz of silver, 3,469,875 lb lead, 2,216,586 lb copper, and 1,269,896 lb antimony.

Comparable 1959 production figures included 234,548 tons milled producing 6,292,492 ox silver, 2,835,541 lb lead, 2,284,618 lb copper and 1,783,258 lb antimony.

The firm reported that exploration of the Chester fault zone on the 4000 level by drifting and diamond drilling has disclosed a new ore body. A limited ore shoot has been indicated in drifting and diamond drilling in the hanging wall of the Syndicate fault. Installation of the sand fill system at the Sunshine mine was reported progressing satisfactorily. Most of the rubber-lined supply line has been installed in the Jewell shaft and a major portion of the surface installation, including the main sand tank and enclosing structure at the head frame is complete. The sand fill system was expected to be ready for use by the start of 1961. East end shaft access was reported as virtually complete on the 3700 and 4000 levels. The shaft has been sunk a short distance below the 4000 level and is now being raised to the 3700 level.

MINNESOTA

Northern Pacific Railway Co. assumed direct control of its lands Dec. 1 by transferring the supervision of geologic studies and related investigations, and mining lease activities from the Eveleth Fee Office to its own office in Hibbing, Minnesota. Northern Pacific "regretfully terminated its arrangement with the Eveleth Fee Office" to effect "more uniform management and to maintain closer ties" with iron ore lessees. Layton C. Binon, mining geologist for the Railway's iron ore properties for several years, will be in charge.

Northern Natural Gas Co. of Omaha on Dec. 7 asked permission of the federal commission to sell natural gas to Reserve Mining Co. at Silver Bay.

About 12-million cu ft of gas would be furnished Reserve daily for use in its pelletizing furnaces and another 14-million cu ft per day for the power plant. In Reserve's testimony before the commission it was stated that, in addition to savings in cost, the use of natural gas would produce better burning conditions in the pelletizing furnaces. Cost of converting present furnaces to the use of gas is estimated at $450,000. Reserve testified that it expects to produce 5.5-million tons of taconite in 1960 with increased capacity for the future.

A total of 69,631,789 tons of iron ore was shipped from U.S. and Canadian Great Lakes ports in 1960. Of the total, 3,728,693 tons was from Canadian ports. The total for 1960 was 22,750,339 tons more than for strike-handicapped 1959. November shipments in 1960 were only 1,942,980 tons against 5,420,904 tons in 1959. Also, in 1959, 3,175,949 tons was shipped in December while no ore left the head of the lakes ports in December 1960.

The Hill-Annex mine at Calumet, Jones & Laughlin Steel Corp., is carrying on a 20-shifts-per-week stripping program. Also stripping are the company's Lind-Greenway, 15 shifts per week and the Schley group at Gilbert, 15 shifts per week. At the Hill-Annex a plant is being constructed to concentrate a large

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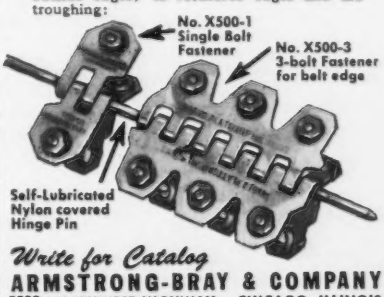
Recommended for mines, quarries, construction work, storage yards — wherever belts length must be frequently changed. Hinged Plategrip Fasteners make a strong, flexible joint in heavy duty conveyor belts, trough naturally, ride smoothly over pulleys, yet can be separated by simply pulling the hinge pin. *Improved* design takes the new smaller diameter self-lubricating nylon sheathed cable hinge pins. No. X500-1 single bolt fasteners and No. X500-3 3 bolt fasteners (used at outside edges) to reinforce edges and aid troughing:



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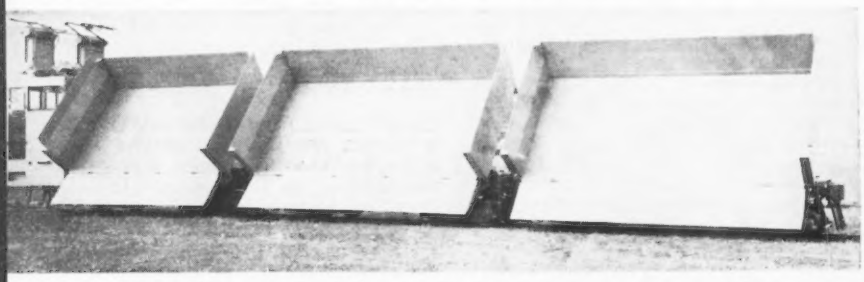

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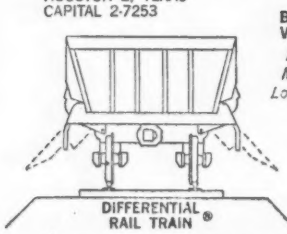

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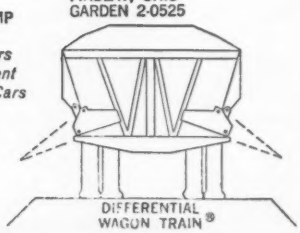

Rent Differential WAGON TRAINS from DIFCO, Findlay, Ohio

Minnesota (*Continued*)

stockpile of cretacious lean ore that has been accumulated during the mine's 43 years of operation—most of it in its earlier years. The plant will include crushing, grinding to 35 mesh, gravity concentration and spirals. Regrinding and flotation will be added later. The plant is scheduled to be in operation in 1961.

The National Safety Council announced Dec. 13 that Erie Mining Company's taconite plant at Hoyt Lakes (Pickands Mather & Co.) had won the Council's Award of Merit. The plant had accumulated 1,428,182 man-hours between June 30, 1960 and Sept. 23, 1960 with no lost time injuries.

Jones & Laughlin Steel Corp. shipped a total of 2,049,830 tons from Minnesota mines in 1960. Highest producer was Lind-Greenway, with 652,148 tons, for its washing plant's first year of operation. No. 2 producer was the Hill-Annex —opened in 1917 and No. 1 for many years—478,406 tons, bringing its total to over 52 million tons. The Columbia at Virginia, No. 3, shipped 239,114 tons, leaving the mine practically worked out after total shipments of 9,259,960 tons. The Hill-Annex tailings reclamation plant turned out 121,596 tons in addition to the mine production. The Longyear at Hibbing and the Schley-Petit at Gilbert also contributed substantial tonnages. 1960 total shipments there exceeded 1959 by 590,067 tons.

The Susquehana open pit at Hibbing, operated by Republic Steel Corp., produced 514,313 tons in 1960. The Susquehanna, one of the Mesabi range's deepest open pit mines, has shipped over 31 million tons to date.

Oliver Iron Mining Division has begun stripping at its Twin City reserve property near Chisholm. Estimated tonnage in the mine is 2,684,868 tons.

Pacific Isle Mining Co., now entirely owned by Inland Steel Co., shipped 614,069 tons in 1960. About 87.3% of this tonnage came from the Iroquois mine near Mt. Iron which now contains an estimated tonnage of about 828,000 tons. The remaining ore came from eight other properties the largest of which was Missabe Mountain south lease with 30,979 tons. The Missabe Mountain north lease is held by Jones & Laughlin Steel Corp. The fee is owned by the state of Minnesota.

Pittsburgh Pacific Co. in 1960 produced 702,970 tons from mine properties and 436,160 tons on the Mesabi range; six properties and 250,400 tons from the Cuyuna range and two properties and 16,410 tons from the Wisconsin portion of the Menominee range. Largest single producer, the Wyoming at Franklin Village, near Virginia, 319,622 tons. No other property shipped as much as 100,000 tons. The Mangan-Joan and West Airport on the Cuyuna shipped 137,272 tons, about evenly divided between them.

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Because of the increased design flexibility and other advantages offered by INDOX V, Stearns engineers were able to achieve dramatic improvements in separator efficiency with the added bonus of low cost.

For example, with the advent of INDOX V it became both *practical* and *economical* to employ permanent magnet radial pulleys or wet permanent drums in ore cobbing applications. And as you well know, these are the jobs that separate the men from the boys.

Stearns pioneered the use of ceramic magnets in mining separators, and the results of this experience can be seen in the large number of *job-proved* INDOX V separator installations in ore processing plants throughout the world. The recent widespread switch to ceramic permanent magnets in the magnetic separation equipment industry gives further proof of the success of INDOX V in these applications.

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MICHIGAN

To give the Cleveland Cliffs Iron Co., time for conducting further tests on the ore body at Bruce Lake in northwestern Ontario, Iron Bay Mines, Ltd. has extended its lease to Feb. 27, 1961. In the meantime a 60 ton sample has been shipped to Ishpeming, Mich. for testing in Cliffs' laboratory there.

Jones & Laughlin Steel Corp.'s Tracy underground mine at Negaunee on the Marquette Range shipped a total of 487,819 tons in 1960 compared to 347,725 tons in 1959. The Tracy is expected to reach an annual output of 1-million tons. 1960 was its best year to date.

Republic Steel Corp. shipped 103,861 tons from its Tobin underground mine at Crystal Falls on the Menominee Range in 1960. This was Republic's only operation in Michigan for the year and was the Tobin's smallest production for at least 13 years.

Lake Superior & Ishpeming R.R., which hauls ore from the Marquette Range to its docks at Marquette, loaded 3,898,495 tons into ore boats during the 1960 season. Record loading time was made on the Pontiac—6759 tons—at the rate of 1000 tons in 8.87 minutes. The Duluth, South Shore & Atlantic docks at Marquette loaded 600,713 tons. Its last boat was on Nov. 7, 56 vessels being loaded during the season.

North Range Mining Co. had one of its best years in 1960: 1,247,006 tons. It operated four mines—one on each of four ranges. The Champion, near Ishpeming on the Marquette range, is its oldest operation. When it took over the mine from the Oliver Iron Mining Co. in 1947, it had been idle for 35 years and had filled with water. North Range dewatered it in 1948 and made its first shipment in 1949. It has been active since that year. The Champion shipped 172,677 tons in 1960, its best year since 1952. The Nahma, near Eveleth, Minn. on the Mesabi range, is a new mine, opened last summer. Its first shipment, in 1960, was 194,518 tons. The Penokee, at Ironwood, on the Gogebic Range, is made up of old properties formerly operated by Oliver Iron Mining Co. The Penokee shipped 512,916 tons in 1960. The fourth mine, the Zenith underground at Ely, Minn. on the Vermilion range, produced 366,896 tons in 1960. It is owned jointly by North Range and the W. S. Moore Co. of Duluth and has been operated by North Range beginning in 1959. The Zenith was operated by Pickands Mather & Co. from 1920 to 1958.

On Dec. 22 the Cleveland-Cliffs Iron Co. announced the closing of its Mather "A" mine on the Marquette range effective on Dec. 30th. It was also announced that the crews at the Mather "B" and Cliffs Shaft mines would be reduced. A total of 480 men were laid off out of about 1850 hourly rated employees. The 'Cliffs mines on the Marquette range are

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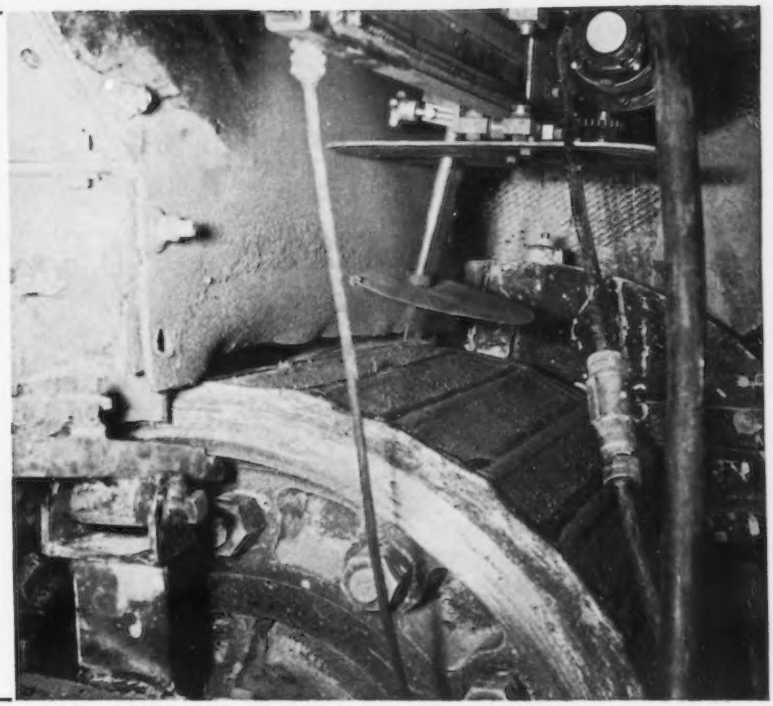

The Stoody CRUSHERMATIC is a new tool for the aggregate producing industry! It cuts rebuilding and hard-facing time on crusher rolls as much as 300 to 400% over manual welding and is 200% faster than hand-held semi-automatic welding!

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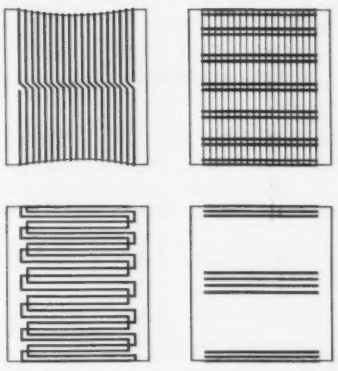
Crushermatic is completely portable... ready to use in 20 minutes. It consists of a reciprocating, motorized carriage and wire nozzle supported on a rail over the crusher roll. Continuous wire, fed through the nozzle, can be deposited in a variety of weld patterns—all made possible by a versatile electronic control and an independent slow-speed roll drive. Crushermatic deposits up to 20 lbs. per hour, utilizing a standard semi-automatic wire feeding unit and power supply capable of 100% duty cycle. Deposits are sounder and more uniform than with manual or hand-held semi-automatic application.

Crushermatic does not replace your weldor—it simply removes him from the cramped smoke-filled area of welding. He sets up the unit, supervises welding *from outside the crusher.* It's safer, faster and eliminates long hours of back-breaking labor.

Detailed Crushermatic data is available from your Stoody Distributor—check the Yellow Pages of your phone book—or write direct!



A wide range of weld patterns can be set up with the electronic controls for rebuilding any specific wear problem.

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An exclusive process extrudes the steel under pressure in a manner that preserves the important grain of the steel and imparts unusual strength to the bit body.

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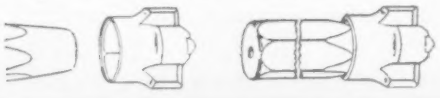

WESTERN ROCK BIT
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Michigan (*Continued*)

the main support of Ishpeming and Negaunee. In 1959, the three mines produced 1,632,537 tons.

MONTANA

1960 mineral production in Montana value totaled $185-million. This was the third highest production value ever recorded, being surpassed only by 1956 and 1957.

Anaconda Aluminum Co.'s plant at Columbia Falls produced at 87% capacity. Production of chromite concentrate from American Chrome Co.'s facilities at Nye exceeded 106,000 tons which was delivered to a government stockpile. Production had risen about 1% over 1959.

Copper production was 93,190 tons in 1960. The ending of the copper strike in 1960 raised production by over 40% compared with the previous year.

Gold production from copper ore increased, but decreased from zinc ore. In 1959 gold production was over 28,000 oz; a year later this figure exceeded 45,000 oz.

Iron ore production totaled 52,380 long tons in 1960, representing about a 5% increase over 1959.

Reduced production of Anaconda zinc ore resulted in a 37% decline of lead production over 1959. Only 4860 long-tons were produced in 1960. Silver output was about the same as 1959; manganese production was higher than 1959's output.

Zinc production declined about 58% compared with 1959. Total production was 11,800 tons as against 27,848 tons. Because of low zinc prices Anaconda announced plans to transfer zinc production from the Anaconda Reduction Works to the Great Falls smelter.

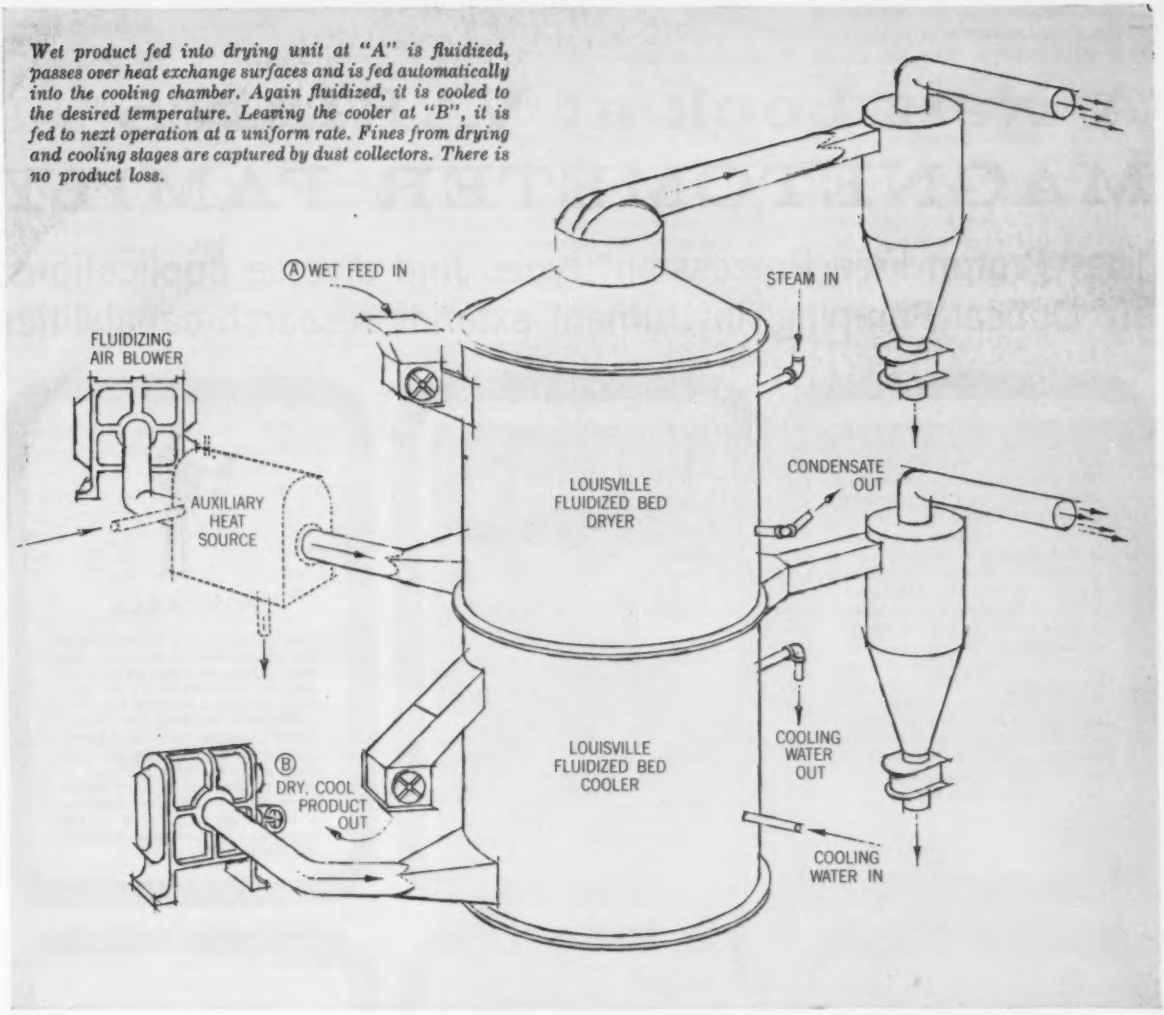
Production of fluorspar, gypsum, lime, mica, phosphate rock, and pyrite increased whereas the production of barite, cement, sand and gravel, stone and talc declined.

Two projects totaling $17-million were announced by Anaconda. One was a five-year $11-million program to bring low-level high-grade ore into production. The other was a modernization program for the Anaconda smelter at Anaconda.

The National Lead Co. barite operation, near Missoula, now employs about 30 men in open pit and underground mining work. The property is located about 30 miles east of Missoula. James Murphy, manager, said mill capacity of the operation is now eight tons of ore per hour. Output is being shipped to markets in seven northwest states.

NEW MEXICO

Extensive revision of New Mexico's mine safety code was recommended to the state legislature in January by a special committee which Gov. John Burroughs appointed last Sept. 11 after a series of uranium mine fatal accidents in the Grants area.


Wet product fed into drying unit at "A" is fluidized, passes over heat exchange surfaces and is fed automatically into the cooling chamber. Again fluidized, it is cooled to the desired temperature. Leaving the cooler at "B", it is fed to next operation at a uniform rate. Fines from drying and cooling stages are captured by dust collectors. There is no product loss.
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COOLING WATER OUT
Ⓑ DRY, COOL PRODUCT OUT
COOLING WATER IN

Major break-through in drying and cooling techniques announced by

GENERAL AMERICAN

A new system for drying and cooling has been perfected by General American Transportation Corporation through their development of Louisville Fluidized Bed* equipment. Two Louisville units, one functioning as a dryer and one as a cooler are coupled vertically to provide a continuous automatic operation.

The system is particularly useful for crystalline chemicals, resins, polyvinyl acetate beads, polyethylene pellets, sugar and similar products having the proper particle size distribution.

Louisville Fluidized Bed equipment offers these advantages:

1. Accurate, instantaneous temperature control
2. High heat transfer that permits compact design
3. Low maintenance costs (no moving parts)
4. Less cleaning time and labor
5. Less floor space (equipment is vertical)
6. No hot spots (product is fully protected)

Because of their simplicity, Louisville Fluidized Bed dryers and coolers adapt readily to complete automation.

For full details about this revolutionary development in drying techniques, write Dept. F.

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A New Look at VARIAN'S MAGNETOMETER FAMILY

The "Proton Free Precession" types find diverse applications; an "Optical Pumping" instrument extends research capabilities.

The simplicity, ruggedness and absolute accuracy made possible by Russell Varian's "Proton Free Precession" concept has made **proton** magnetometers the world standard in less than a decade. Using this principle, total magnetic intensities are quickly measured, without critical orientation or calibration requirements. Recent application of the "Optical Pumping" concept has enabled Varian Associates to develop a **rubidium vapor** magnetometer, with the highest sensitivity available today. This new instrument measures total magnetic intensities on a continuous basis.

OBSERVATORY

Varian's V-4931 Modular Station Magnetometer **(proton)** is a highly versatile and accurate monitor of the earth's magnetic field. Strip-chart analog records and digital readout are supplemented by printed-tape output which may be engaged, as desired, to provide permanent digital records. The V-4934 Station Magnetometer **(rubidium vapor)** is particularly suitable for measuring and recording geomagnetic micropulsations.

PORTABLE

The Varian M-49, a complete **proton** magnetometer weighing less than 20 lbs., furnishes direct readings in gammas every six seconds. Sensitive to better than ±10 gammas, it requires no calibration or levelling and is so versatile it can make equally accurate field records from surveys on land, in the air, or over water. Eight plug-in tuner ranges, equally spaced from 19,000 to 101,000 gammas, allow operation throughout the world.

AIRBORNE

The V-4914 Airborne Magnetometer **(proton)** is a rugged, lightweight and compact version of Varian's Station Magnetometer. Sensitivity and accuracy are of observatory quality. Coarse- and fine-scale strip-chart records may be supplemented with punched-tape. The virtually indestructible "bird" contains no mechanical or electronic parts. Varian's V-4914 is easily accommodated in single-engined aircraft. Range: 22,500 to 73,400 gammas.

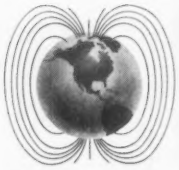
OCEANOGRAPHIC

An accessory "fish" towed up to five hundred feet astern of the hydrographic vessel is the sensing adjunct to Varian's V-4931 for oceanographic survey work. Suitable for broad-scale undersea mapping or offshore geophysical exploration, it furnishes information of observatory quality. Analog and digital readout and records, accuracy and operating range are identical to the observatory model.

RESEARCH

Examples of current projects in Varian's research and engineering laboratories include **proton** and **rubidium vapor** miniaturized magnetometers stressed for missile, satellite, and deep-space applications and instruments being developed for specific military applications, such as ASW. Varian's practical contributions to magnetometry are continuing to advance the state of the art.

For further information on magnetometer sales or leases in many countries of the free world — For loan of the Varian 16 mm color and sound movie on proton magnetometry — For copies of Varian's new Geophysics Technical Memorandum Series — call, wire or write Instrument Division



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New Mexico (*Continued*)

Ironically, the 16th uranium mine death of 1960 occurred as the committee was holding the latest in a series of meetings (Dec. 29) in Albuquerque. The victim: Warren L. Harris, 36, father of six children, fatally injured when a slab of stone fell on him in Kermac Nuclear Fuels Inc. Section 17 Mine in the Ambrosia Lake area.

One recommendation urges that the state mining inspector be given authority to revoke bonus production payments where he believes they jeopardize lives and health. This represented a modification of an earlier recommendation that incentive payments be abolished entirely.

Joe Apodaca, representing District 50, United Mine Workers, in Grants strongly opposed a blanket recommendation to eliminate incentive payments.

By such action, he said, "we are putting ourselves in the position of cutting miners' wages." He estimated some miners would be cut from an average $7 to $9 an hour all the way to the base of $2.70 an hour. Under the bonus plan some mine workers earn between $1500 and $2000 a month, Apodaca said. He estimated 70% of the miners in the Grants area are under the bonus program.

Tom Robles, head of the New Mexico AFL-CIO, who favored elimination of incentive payments, said "I'd rather have the miners mad at us than have their widows and children mad at us if they're killed."

Ray Clark of Carlsbad, AFL-CIO Stonecutters representative, noted the hazards of uranium mining do not apply to potash recovery in the Carlsbad area and that while only two companies there have production bonuses, some of his union members would face a pay cut of about 11c an hour if the bonus were stopped.

American Zinc, Lead and Smelting Co. and Hydrometals, Inc. announced that mining and milling operations at Silver City and Deming, N.Y. were resumed Jan 2, 1961. American Zinc agreed to acquire from Hydrometals, Inc. a 50% interest in the zinc properties November 1959, and has conducted an extensive surface and underground exploration program during the past year. This work has been successful in indicating a substantial tonnage of commercial grade ore.

NEVADA

Nevada had 103 mining operations active during 1960, as compared to 110 in 1959; but employment in the mining industry increased from 4750 to 4762. Gold production was lower during the year because Round Mountain Gold Dredging Co., which was producing an average of 360 oz of gold per day during 1959, was not in operation during 1960.

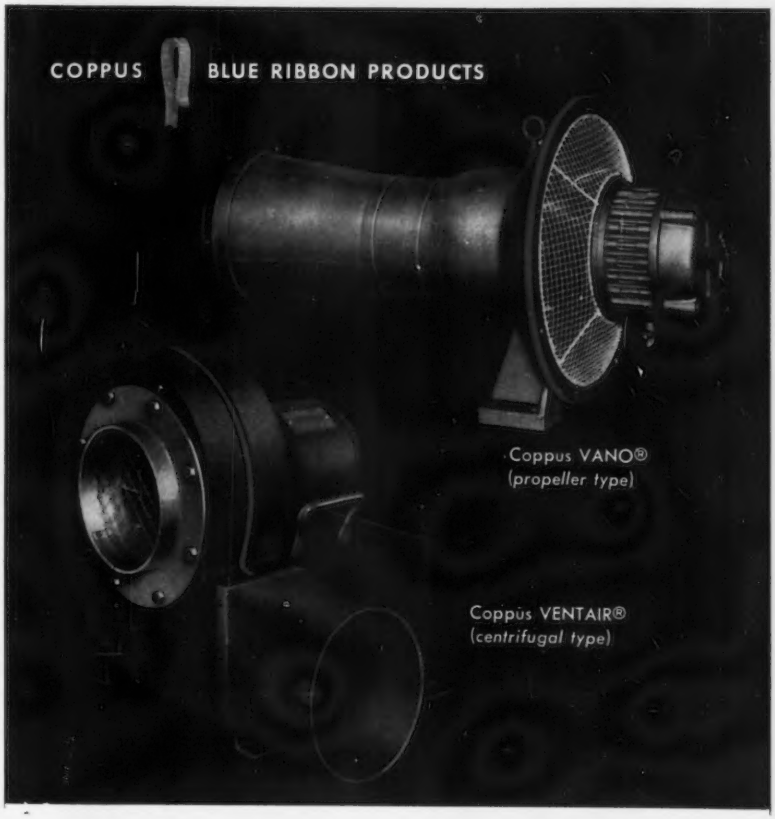
Silver production increased during the year, due largely to the U.S. Milling & Minerals operations at Silver Peak and in the surrounding area, and also to the completion of the Argentum Mining Co. mill, largest precious metals treatment plant in the state, which went into operation in mid summer, using Esmeralda, Nye and Mineral County ores.

Twenty-three mine and mill operations handled gold and silver during 1960, and employed a total of 330 men. Kennecott operations in White Pine county and Anaconda operations in Lyon and Churchill counties provided jobs for 1947 people. Second was titanium, which provided employment for 578 people, all at the Titanium Metals Corp. mine and mill in Clark County.

Gypsum operations by U.S. Gypsum Co. were in northern Washoe and Pershing Counties, and by Flintkote Co. in Clark County, Eagle Picher in Pershing and Stor Counties, Great Lakes Carbon Corp plant in Esmeralda County, and the Aquafil plant in Lyon County processed diatomaceous earth.

Magnesite production at Gabbs continued high, and Basic Inc., and Standard Slag together provided work for 235 people. Mercury operations maintained an important place in the Nevada mining picture: the largest is the Cordero mine in northern Humboldt Co.

Iron production showed a slight increase during the year, despite the fact that Mineral Materials Co. operations ceased early in 1960 when its facilities were taken over by U.S. Steel Co. The transaction between the two firms was the largest during the year. U.S. Steel



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Coppus Blowers for mine ventilation include the centrifugal VENTAIR for long pipe lines and the propeller-type VANO for shorter lines. For a given power consumption both deliver from 30% to 100% more air than an ordinary fan.

Serving as blowers or exhausters they are driven either by electric motor or compressed air, with capacities up to 60,000 CFM. Like all Coppus Products, these blowers carry the same "Blue Ribbon" assurance of quality and dependable performance.

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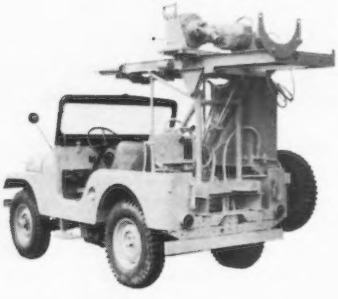

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Nevada *(Continued)*

paid Mineral Materials $900,000 for its iron ore upgrading mill in Mineral Basin, Churchill county, and also took a two-year purchase option on Mineral Materials claims in the area.

Manganese production remained high during the year, the chief operation being that of Manganese Inc. in Clark county. Other 1960 mineral products were perlite silica, dolomite, barite, fluorspar, barium, antimony and uranium. Apex Minerals Corp. and Valley View Mining Co. maintained regular shipments of uranium ore averaging 200 tons weekly from their properties near Austin.

Construction projects largely dominated the news during 1960. Anaconda Copper Co. started a $6-million addition to its refining plant at Weed Heights to handle sulphide ores; Basic Inc. completed a multi-million dollar expansion project at Gabbs, which included a new refractory plant, a rotary kiln, a flotation mill and other facilities; Argentum Mining Co. completed its big mill and tramline system at Columbus Flat west of Mina after several years of work; and the Bognadich Development Co. built a 75-tpd mill and other facilities at Mountain City in northern Elko county to handle gold-silver ores.

Much exploration was carried on during the year. Columbia Iron Mining Co., a subsidiary of U.S. Steel, diamond drilled in Mineral Basin and in Mason Valley during most of the year. Kennecott Copper Co. carried out an extensive drilling program north of Yerington for new copper ore deposits. Leprechaun Mining & Mineral Co., of Las Vegas, explored extensively in Clayton Valley, Esmeralda county, in search of nonmetallic values; and Utah Construction Co. conducted diamond drilling explorations for iron ore north of Dayton in Lyon county.

Getchell Mine Inc. late in 1960 sold its holdings in northern Humboldt county to Goldfield Consolidated Co. For many years the Getchell Mine played a dominant role in the Nevada mining picture, producing both tungsten and gold ores.

The possible application of several of Nevada's little-known nonmetallic minerals to important uses in industrial processes has been described by Dr. Richard H. Olson, Assistant Economic Geologist of the Nevada Bureau of Mines, University of Nevada.

Speaking before the monthly meeting in Reno of the American Institute of Mining and Metallurgical Engineers, Dr. Olson revealed that recent research with naturally occurring zeolites indicates that the minerals can be adapted at greatly reduced cost as substitutes for expensive synthetic compounds now used as filters in the manufacture of high-octane gasoline, as dessicants, and as catalyst carriers in various chemical processes. Minerals included in the category are erionite and clinoptilolite which result from alteration of volcanic glass under alkaline conditions.

Dr. Olson described the exploration

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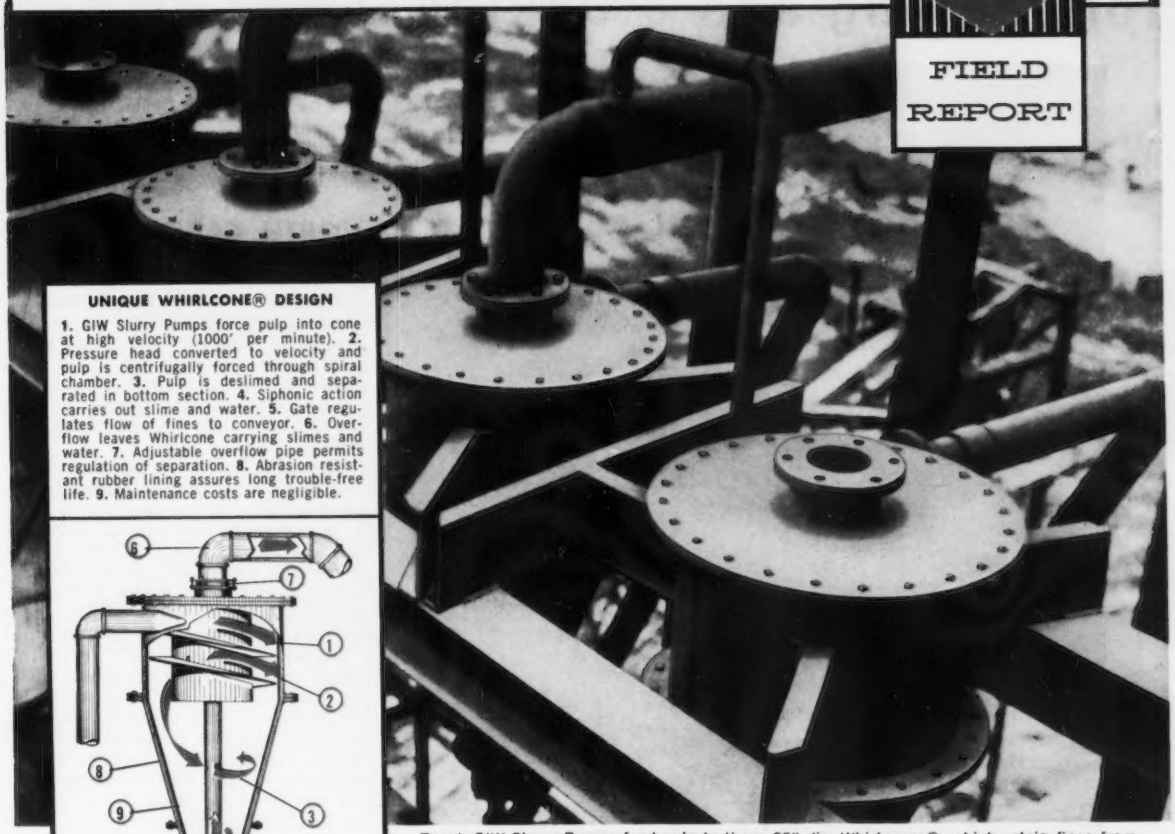
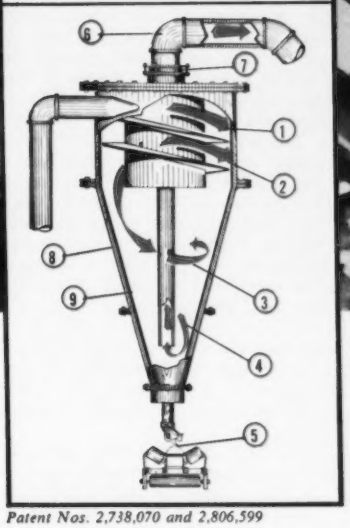
GIW

FIELD REPORT



UNIQUE WHIRLCONE® DESIGN

1. GIW Slurry Pumps force pulp into cone at high velocity (1000′ per minute). **2.** Pressure head converted to velocity and pulp is centrifugally forced through spiral chamber. **3.** Pulp is deslimed and separated in bottom section. **4.** Siphonic action carries out slime and water. **5.** Gate regulates flow of fines to conveyor. **6.** Overflow leaves Whirlcone carrying slimes and water. **7.** Adjustable overflow pipe permits regulation of separation. **8.** Abrasion resistant rubber lining assures long trouble-free life. **9.** Maintenance costs are negligible.



Patent Nos. 2,738,070 and 2,806,599

Tough GIW Slurry Pumps feed pulp to these 25″ dia. Whirlcones®, which retain fines from classifier overflow. Maximum recovery rate is 20 tons per hour per cyclone. The cones will handle material from −12 mesh to lightest slime.

Whirlcone® Separators solve difficult fine recovery problems.

The retention of fines in the −50 plus 200 mesh range posed a disturbing problem for the Becker County Sand & Gravel Co., of Cheraw, S.C., primarily because the large amount of water used in processing the sand and gravel washed out the desirable fines with the minus 200 slimes.

Fourteen 25″ dia. Whirlcone® wet type cyclones installed parallel in four Becker plants solved this problem completely. Operating an average of 8 hours daily, they extract up to 100 tons of clean, fine sand per hour from wash water while the minus 200 mesh slime is discarded.

Recovered fines are used to bring sand up to specifications. Thousands of tons of valuable sand, formerly lost, soon paid for the low cost of the Whirlcones®.

GIW's highly efficient Whirlcones® are also being used in the mining fields to deslime, degrit, classify, concentrate, make dam and mine backfill and to dewater or thicken where the overflow can be returned to the process or it can be discarded.

They are available in diameters from 6″ to 50″. Capital cost including the pump is 20 to 50% of conventional classifiers.

If you are losing fines from material −12 mesh to lightest slimes, write today. Recommendations and literature will be forwarded promptly.

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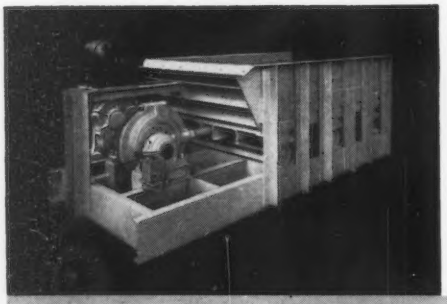

These feed controlled quantities of all materials, from fine sand to shovel-loaded rock —with very low operating costs.
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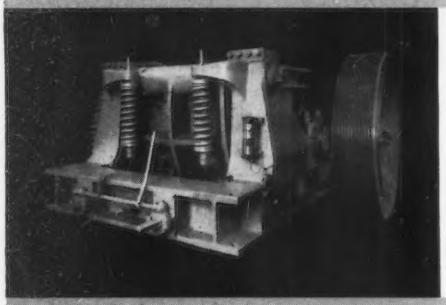

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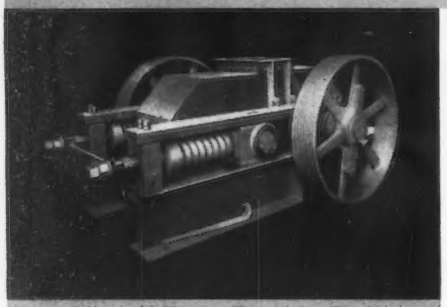

Great capacity, very low maintenance cost per ton — industry's pace setters for finer reductions of medium sized feeds.
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Nevada (*Continued*)

for these minerals in the western U.S. and particularly in various parts of Nevada. Before the present discoveries, erionite was one of the world's rarest minerals. It could be seen in museums in quantities of less than one pound. The recent exploration in which Dr. Olson participated revealed deposits in excess of 1-million tons. Five of the six newly discovered deposits of erionite were found in Nevada. The extensive volcanic formations in the State provide a natural habitat for the zeolite family of minerals.

NORTH CAROLINA

In 1960 the state enjoyed a record mineral production valued at $43.2-million. Copper production was 26% higher, the amount of tungsten mined was more than double that of 1959, and a substantial tonnage of lead was produced.

The production of asbestos, olivine, and lithium minerals was about the same as 1959.

The most recent significant mining developments have been the finding of commercially valuable deposits of gold in Montgomery and Rowan Counties, lead and zinc in Davidson, iron ore in Avery and weathered volcanic ash in Moore, state geologist Jasper L. Stuckey told the N.C. State Board of Conservation and Development in January.

Stuckey, in pointing to a revival of interest in gold mining noted that Whitney Reduction Co. has been formed to reopen the old Whitney gold mine near Gold Hill and that Union Refining and Mining Co. is continuing development of the old Star gold mine in Montgomery Co. and plans to install a modern refinery to produce gold ore. He said he had been informed that gold ore from the Star mine was assaying at about $20 per ton and that some gold ore samples there have been "fabulous," although they could not be considered representative.

Stuckey added that the discovery of lead and zinc in commercial amounts at the Silver mine in Davidson County is considered by many to be "the recent mining highlight of the southeast." He noted that the Tennessee Copper Co. is developing the mine there and is ready to begin operations.

About 100 tpd of iron ore are being mined at the old Cranberry magnetite mine in Avery County by the Cranberry Magnetic Corp., Stuckey said, and is being stockpiled at Cranberry where the company plans to build a modern electric smelting furnace to produce high grade iron.

Ceramic Minerals Inc., of Carthage, Stuckey reported, is developing deposits of weathered volcanic ash in the vicinity of Robbins in Moore County and estimates of the deposit range up to 30-million tons. He said Ceramic Minerals plans to build a processing plant at Eagle Springs and noted that volcanic ash produces a blend of brick not now made in North Carolina, already the fourth brick producer in the nation.

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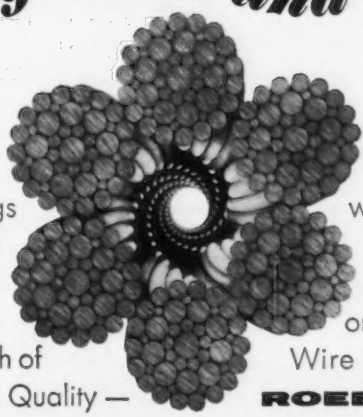

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The underground haulage involves up to 300 tons per day of 0.7 percent U_3O_8 ore. Each Card Granby car has a capacity of 41 cu. ft. and is built on 24" gauge. When the Radon orebody is exhausted, the cars will still be able to "outlive" another Hecla mine of comparable size without major repair or replacement.

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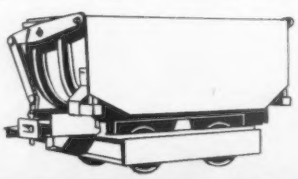

C.S. Card Iron Works Co.
2501 WEST 16TH AVE.
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OREGON

The Hanna nickel mine near Riddle in Douglas County and the Bretz mercury mine in Malheur County were the only sizeable producers in 1960.

The White King Uranium mine in Lake County was idle nearly all year after producing a large tonnage in 1959. Late in 1960 some production was recorded from the Lucky Lass claims near the White King mine. The mill at Lakeview processed some uranium ores from Alaska and Nevada.

Hanna's mine and smelter operated at capacity levels as nickel provided the lone bright spot in the state's metallic mining. Output of nickel silicate ore from the open pit mine totalled 840,000 tons. Smelter output was approximately 22-million pounds of nickel contained in ferronickel.

The Bonanza mercury mine in Douglas County was shut down Oct. 1, leaving the Bretz mine the lone active producer in the state.

Gold production, mostly from about 25 placers, was estimated at 674 oz, compared with 686 oz in 1959.

Wah Chang Corp. installed rolling mill equipment early in the year at its Albany rare metals plant to reduce ingot to rod, sheet, plate and other forms. The company produced zirconium, columbium, tantalum and hafnium metal from ore and concentrate at its refractory metals facility, which expanded greatly during the year.

TENNESSEE

In 1960, Tennessee attained a record copper production of 13,000 tons. This was 13% over the record for 1959. Zinc production, which was hampered by strikes, was 1% over the record 89,932 tons of 1959.

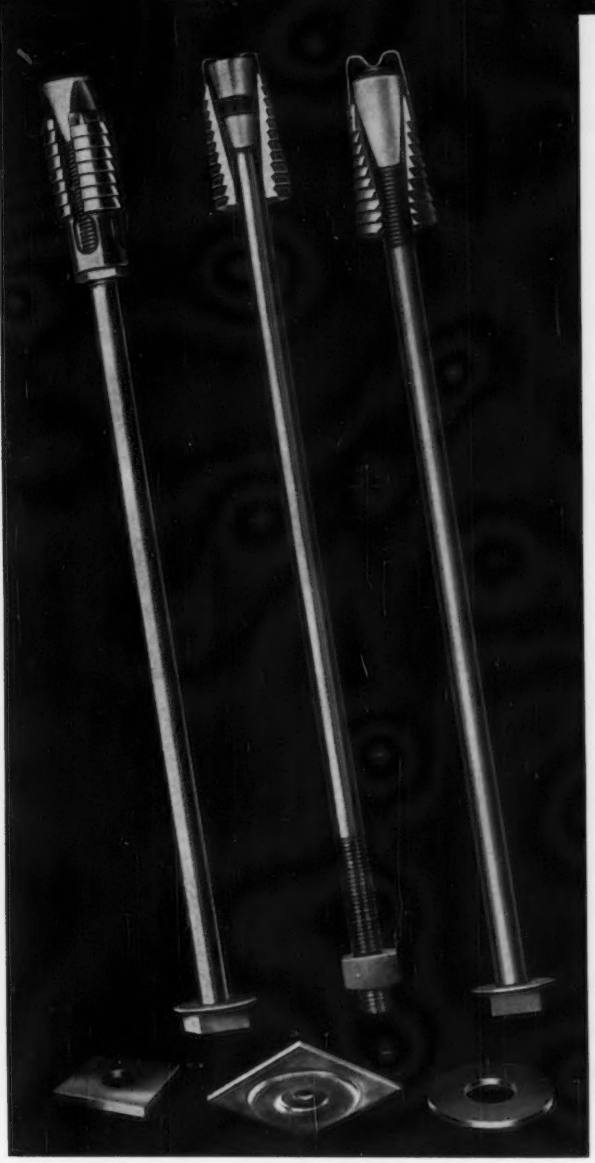
Total mineral production for the year was estimated to be $143,287,000, which is 2% over the record of 1959.

The recent drop in the price of zinc caused a sharp reduction in diamond drill exploration in the Mascot-Jefferson City zinc district. Joy Manufacturing Co., the only contract diamond driller in the district, now has two single shift diamond drills operating. During the period of DMEA loans, Joy had as many as 16 drills operating, most of them on either a two or three shift basis.

New Jersey Zinc Co. has a diamond drill exploration program under way near Luttrell. The drill is penetrating the entire Kingsport formation of the Knox dolomite in an effort to locate zinc orebodies. New Jersey's Treadway mine is located northeast of the Luttrell area and in the same strike belt of the Knox dolomite.

WASHINGTON

Pend Oreille Mines and Metals Co., Spokane, estimates 1960 output at 720,-



THREE OF THE MOST WIDELY USED Republic Roof Bolts, left to right, are: square head bolt with RS-1 expansion shell, forged steel wedge head bolt with cast rigid expansion shell, square head bolt with RE-3 bail type expansion shell. Other designs are available to meet particularly unusual requirements.

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In the past fifteen years, as roof bolting really came of age, two important facts became apparent. First, no one bolt is versatile enough to meet all mine roof conditions. Second, in making a selection, a precise knowledge of the effectiveness of various bolt designs when used in different types of strata is needed.

Republic helps you solve both problems. Buy Republic and you choose from the largest selection of roof bolts available anywhere. And field trained Republic Mine Roof Bolt Engineers work with you in selecting or developing a bolt that exactly fills your requirements... *the best bolt for your mine.*

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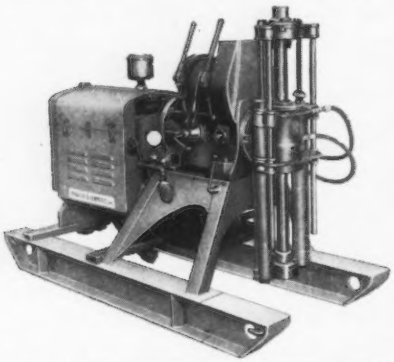

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Washington (*Continued*)

000 tons of ore mined and milled at the Pend Oreille mine near Metaline Falls, Wash. Estimated production includes 9000 tons of lead concentrates and 25,000 tons of zinc concentrates.

This compares with 619,779 tons mined and milled in 1959 and production of 10,506 tons of lead concentrates and 18,992 tons of zinc concentrates.

President Jens Jensen reported a normal amount of development and drilling work at the mine during the year. He said the company's 2400 tpd mill has been running at from 66- to 80% of capacity in 1960. Lead concentrates have been stored at the Pend Oreille property since May because of the strike at Bunker Hill at Kellogg, Idaho. Officials hoped to resume shipments to the Bunker Hill lead smelter in January 1961, with the settlement of the Bunker Hill strike in December 1960.

A third furnace went back in operation in January at the Keokuk Electro-Metals Co. plant at Rock Island. The action involved the recall of about 20 men. The furnace at the silicon production facility had been shut down since July 1. Only one of the firm's four furnaces is now idle.

Dawn Mining Co., a subsidiary of Newmont Mining Corp., New York, mined 160,827 tons of uranium ore at two leases on the Spokane Indian reservation in 1960. This included 116,825 tons at the Midnite lease and 44,002 tons at the Peters lease.

Dawn milled 164,029 tons of company ore and 7227 tons of custom ore at its 400 tpd mill at Ford during the year. Most of the custom ore was from the Mt. Spokane mining district.

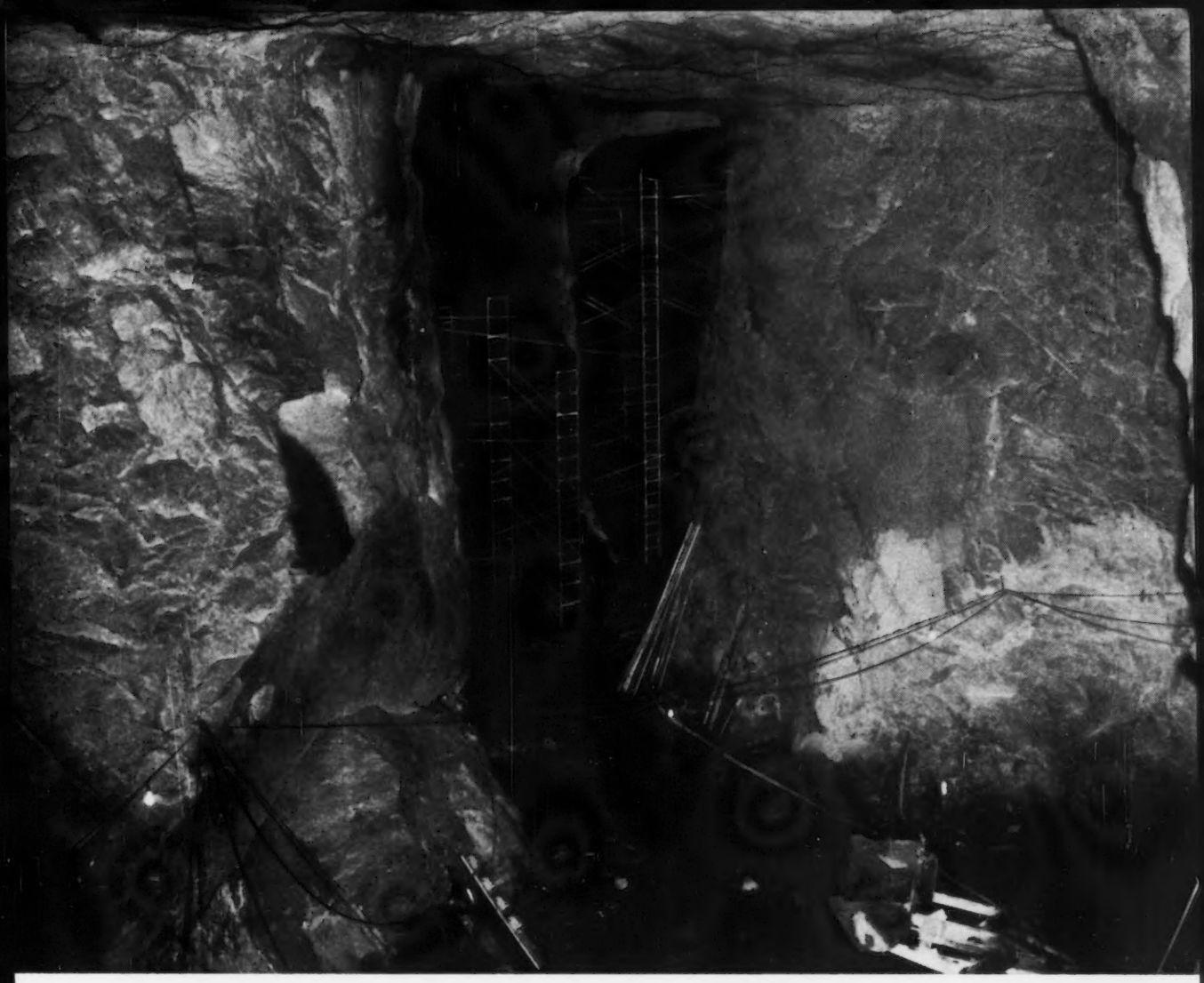
Officials said ore reserves of more than 1-million tons at properties on the reservation will assure mining and milling will continue at about the same level through the current AEC purchase contract (to 1966). The company expects 1961 operations to continue at the 1960 level.

Day Mines, Inc., Wallace, Idaho, has leased eight mining claims in the gold mining district near Republic, to Harold G. Badgley and W. A. Nations, of Republic. The properties are about three miles from Day's Gold Dollar property which is being operated by Knob Hill Mines. Stripping operations are planned by the lessees.

Daybreak Uranium, Inc., Opportunity, shipped 450 tons of uranium ore from the Dahl lease on Mt. Spokane in 1960. The firm also placed about 800 tons of ore in stockpile and reported a new discovery at the Dahl lease near the original Daybreak mine.

ALABAMA

According to USBM, in its 1960 mineral survey, bauxite production in the state increased 14%. Some 4600 tons of iron were mined, a 10% increase over 1959 production.



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Uncontrolled water flow was entering this 250,000 bbl. LPG underground storage cavern through fissures — some as wide as ¼" — in the ceiling and sides of the cavern during its excavation.

To stop this troublesome water problem, the mining engineer called on Halliburton Pressure Grouting Service. Since prior grouting jobs using conventional materials and methods had failed to stop the water flow, Halliburton recommended treatments with HYDRO-LOK (PWG). This is a low-viscosity chemical grout with a controlled fluid time, allowing it to reach the water bearing zones. It then sets very quickly to form a stiff gel effectively sealing off the flow of water.

Some 600 separate injections of HYDRO-LOK (PWG) were made, varying from 3 gallons to 800 gallons each. A total of 7,946 gallons of HYDRO-LOK (PWG) and 736 gallons of Halliburton Hydromite was pumped into the fissures existing throughout the cavern. After 33 working days, more than 95% of the water flow had been stopped.

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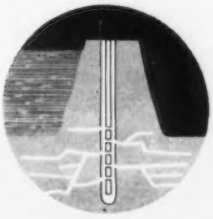

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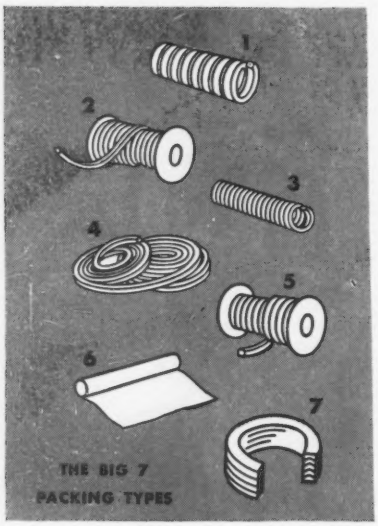

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WEST VIRGINIA

W. C. Curnutt has recently recommended for approval a permit to prospect for iron ore in Jefferson National Forrest. Curnutt, forest supervisor, expects immediate approval from his superiors in the U.S. Forest Service. Approval will clear the way for E. L. Keesling of Bramweel, W. Va. and his co-workers to determine if deposits of low-grade iron ore can be processed for use in a steel-making industry.

Research still under way at Virginia Polytechnic Institute has indicated that the deposits—with 23 to 27% concentrate—can economically be refined for industrial uses. If this is proved, the New River valley, with ample water and other steel manufacturing resources, might become another steel center. Costs for assembling steel-making materials would be lower than those in any of the existing steel centers in the U.S.

Keesling presented a report on land restoration methods, a much discussed topic of the project and particularly important if quarry-type operation is used. His plan includes using the waste material from the ore recovery process—a non-solvent, ground rock—in restoring the land from which the ore is to be taken.

Dr. Byron Cooper, VPI geology department head, who is doing further testing, has estimated that reserves in the 1,500-acre tract in Giles County, Va., inside the forest, are sufficient to provide every year for 150 years, 1-million tons of ore, refined to a 50% concentrate.

Also on record for the proposal are Senator Robert Byrd, Virginia Governor J. Lindsay Almond and West Virginia Governor-elect W. W. Barron.

UTAH

A renewed exploration drive, statistical improvements in production of nonferrous metals and major events in phosphate and potash fields characterized Utah mining in 1960. Major nonferrous metals production was up in some cases over a six year average but this picture was slightly colored by the effects of strikes of 1959.

Copper production was up 58% over 1959 and 8% over 1958 with an estimated 433,300,000 lb. The 1959 production—almost solely from the Bingham open cut mine of Utah Copper Division, Kennecott Copper Corp.—was 284-million lb. The mine worked most of 1960—with the exception of a few months at the start of the year, on a full-time, three-shift basis.

Reduced production resulted in 1958 because of the recession and the world over-supply which tumbled prices.

Zinc production attained a recent all time high of 96.3-million lb, while lead output was second only to the postwar boom year of 1957 with 101.3-million lb. (estimated).

This phenomenon, following a 10 year slump in the production of lead, silver, and zinc production can be attributed to several factors. First, the 1959 shutdown of the Tooele smelter of International Smelting & Refining Co. resulted in a substantial stockpiling of concentrates. New Park Mining Co., United States Smelting Refining & Mining Co. and United Park City Mines Co. continued production during the smelter strike.

The smelter, which has shut down on occasion because of lack of concentrates operated on a two-shift basis when the strike ended.

Both New Park and United Park City attempted, where possible, to hoist more ore to overcome rising unit costs with greater volume output. In late 1960, both mines started to bring in newly developed and somewhat higher grade ore. The price reductions of lead and zinc complicated these efforts.

Gold production—largely from the Bingham mine—was up 50.6% at 340,-000 oz over the 1959 output of 226,100 oz, but about average for a six year period.

Uranium is estimated in the 6-million lb range, compared with the 1958 all-time high of 7,798,000 lb, when Utah was the biggest producer of uranium concentrates in the nation.

The Federally-owned Monticello mill shut down during the year.

Utah's iron ore production was placed at 3-million tons in 1960. This shows a slight increase over the strike affected 1959 production when steel makers consumed only 2,842,000 tons of iron ore. In 1958, output of the iron mines in the southwestern part of the state was 3½-million tons.

The decline reflects the stretch-out of production contracts in the new domestic program, and of processing of concentrates at the government-owned Monticello mill, and a reduction in operating rate at Vitro Chemical Co.'s mill during the last half of the year.

Anaconda Co. has announced it has taken options on a large area in the old San Francisco mining district north of Milford in western Utah for the open pit development of a newly discovered porphyry plug. Substantial drilling is now underway.

Vitro Chemical, a division of Vitro Corp. of America and Beryllium Resources Co., announced the discovery of major deposits of a disseminated type beryllium ore on Spor Mt. in the Topaz Mt. mining area northwest of Delta in western Utah. Beryllium Resources is controlled by Hidden Splendor Mining Co., Federal Resources Corp., and Brush Beryllium Corp.

Bear Creek Mining Co., the domestic exploration affiliate of Kennecott continued substantial extension of a very high-grade lead-silver-zinc orebody in the Tintic Unit at East Tintic District. The firm also commenced sinking of an incline winze to determine operating conditions and location of a production shaft.

Kennecott's Utah Copper Division completed a $16-million addition to its central station steam-electric generating plant to hike output of its copper complex. A drop-spiral type connection was started at the bottom of the Bingham mine to hasten the placing of a major

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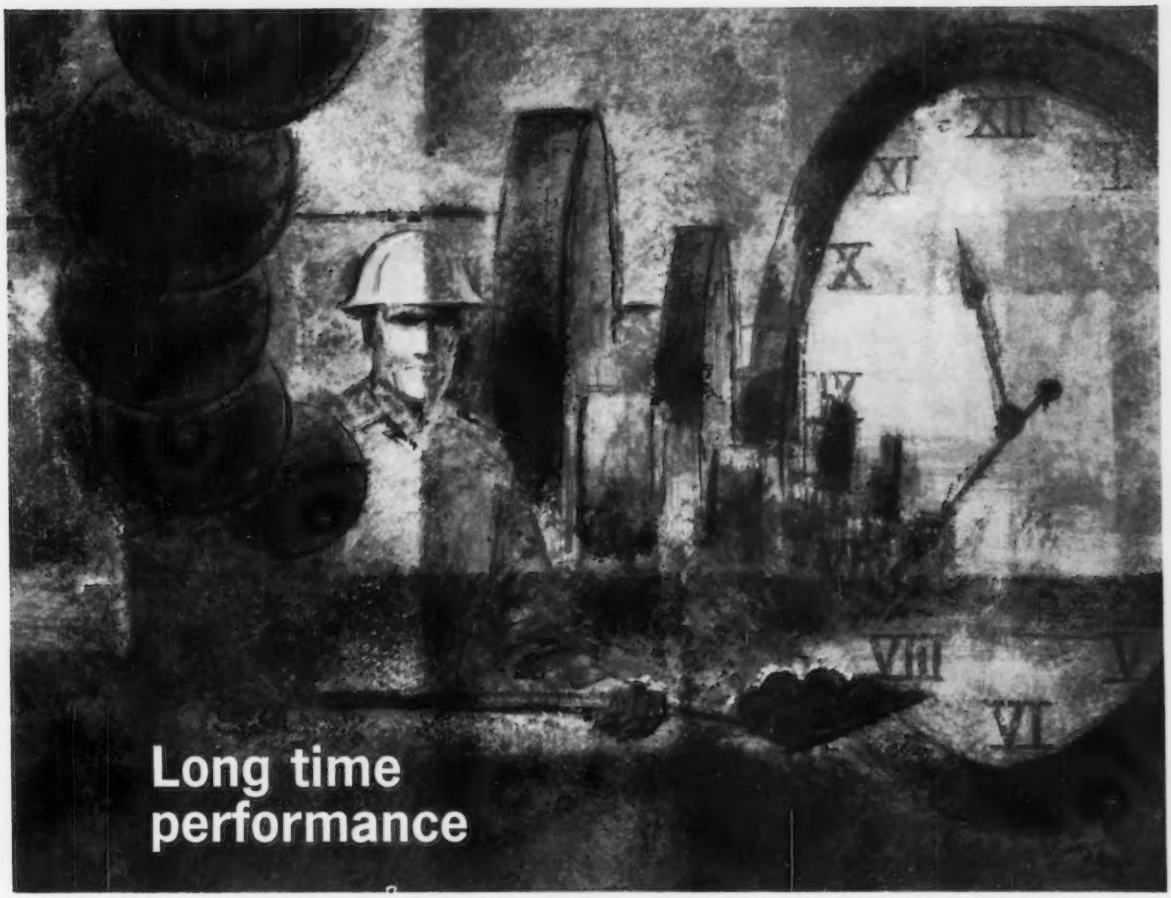

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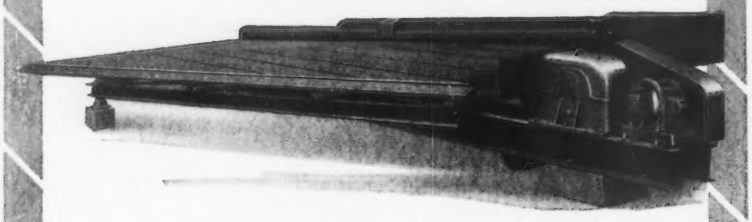

The SuperDuty® table easily leads the field because its designers have taken seriously the obligation of considering all related concentrating factors as a combination necessary to most efficient performance.

The smooth running anti-friction head motion with its definite "kick" produces a deck action for alert separation and directing of heavy gravity values to concentrates. 70% more working riffles help to provide accurate selection of concentrate bands for easy cutting. As a result, minimum loss to tailings and substantial reduction of middlings increase recovery and make more room for extra tons of new feed per day.

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Utah (*Continued*)

mine ore haulage tunnel finished in 1959.

Utah Copper Division of Kennecott also announced plans for a $10-million renovation of the Garfield smelter which it has acquired as of Jan. 1, 1960 from American Smelting & Refining Co. The company has also begun a program of oxygen smelting experimentation at Garfield. The value of this process won't be known for a while, but the world's biggest copper company is making a sizeable investment in the experiment.

The firm's research center made major advances in the processing of rhenium metal and molybdenum roasting.

In Utah's Uintah Basin, San Francisco Mining Co. is building a major open cut mine which will produce a portion of the 700-million ton Humphreys phosphate deposit. The firm, an affiliate of Stauffer Chemical Co. also completed the first stages of a major mill complex near the mine, 15 miles north of Vernal.

Texas Gulf Sulphur Co. will exercise their options from the Delhi Taylor Oil Corp. on the big Cane Creek potash deposit on the Grand-San Juan County line. TGS will spend some $30-million on mine, mill and rail connections in 1961. It plans to be in production at what will be the single largest potash complex in North America by end of 1962.

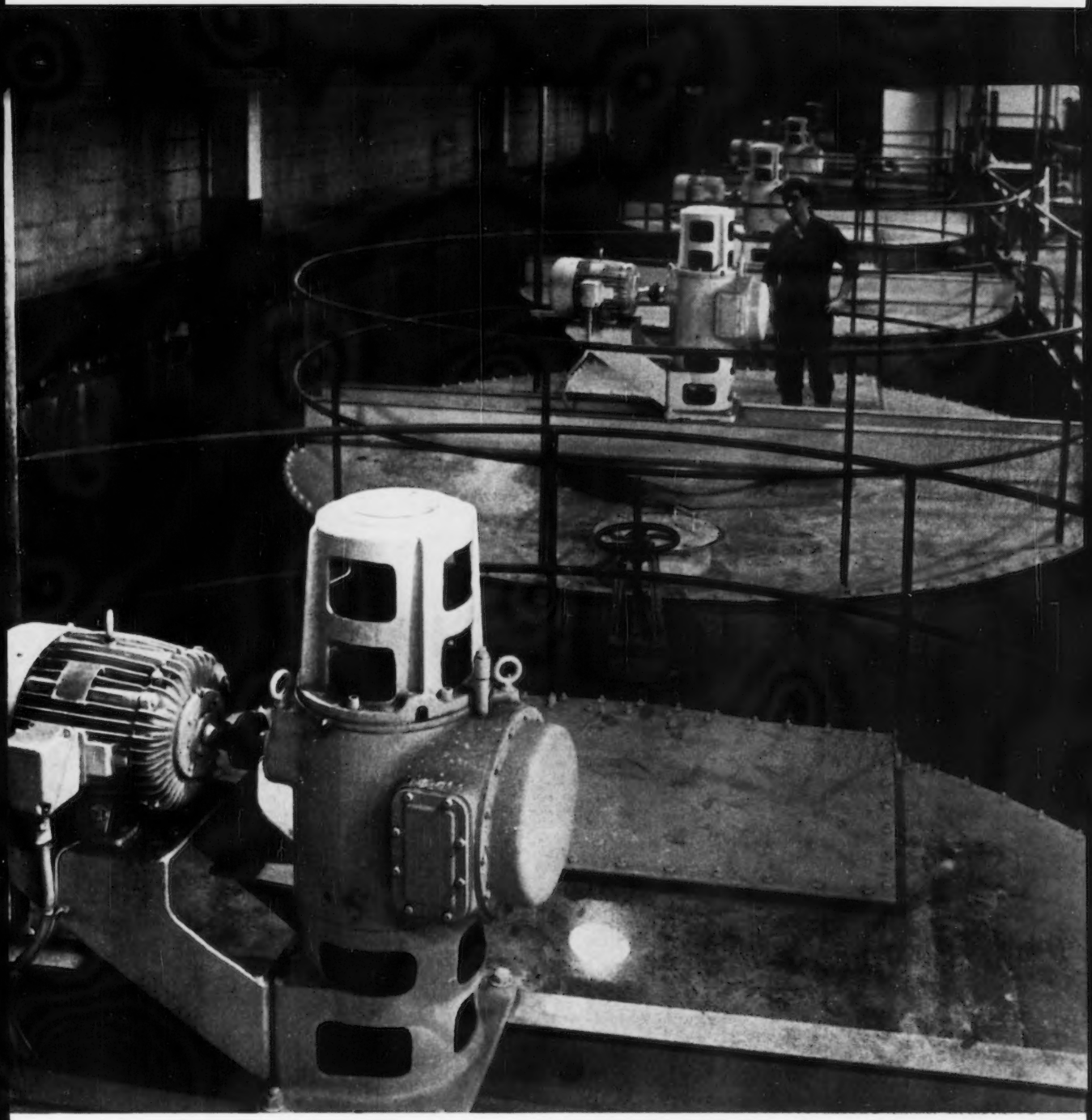
WISCONSIN

Herb Turner, Jr., of Boscobel, has sold his mining interests in the Wisconsin-Illinois lead-zinc district to the newly reorganized Mifflin Mining Co., Inc., John F. Howland, president, Walter Hennes, vice president. Included in the sale are: the 150-tpd Coker Mill, adjacent to New Jersey Zinc Co's. Coker property, three miles northeast of Rewey; the headframe and equipment at the Rasque Mine, five miles south of Platteville, Grant County; and the Dinsdale Mine, two miles northeast of Galena, Jo Daviess County, Illinois. The company holds additional mining leases in the district that bring the total to 1500 acres under lease.

Mifflin Mining Co. has reconditioned the mill and revamped the flowsheet so that it now consists of a crushing unit and a flotation unit; the gravity separation unit is available but not integrated at present. The Coker Open Pit and adjoining Coker #1 Mine have been dewatered and ore is being mined from the major New Jersey Zinc portion and from the Bickford extensions.

Ore is crushed to 90% minus ¾-in. and ground to minus 65 mesh. Lead is removed in a four-cell bank of Denver Equipment Co. Special 18 cells, and the pulp is then conditioned before entering the zinc circuit of 10 Denver Equipment Company No. 18 cells in two banks: one bank of six cells, one bank of four cells. Lead is finished on a shaker table, zinc on a 6-ft, 2-disc Eimco filter.

Zinc concentrates are shipped under contract with the Eagle-Picher Co. to its Galena, Kansas plant.



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WYOMING

Diamond Alkali Co. is expected to announce the start of a major trona (natural soda ash) project, 25 miles west of Green River, in 1961, according to Green River sources. The firm has spent an estimated $1-million in core drilling on the trona beds in the last 1½ years. It has, however, made no reserve or cost estimate on mine and beneficiation plant.

Diamond would be the third major chemical producer to get into the soda ash business in southwestern Wyoming, an area of hundreds of millions of tons of trona reserves.

Intermountain Chemical Co. (National Distillers Chemical and Food Machinery and Chemical Corp.) pioneered the mining and beneficiation of trona in 1948. Subsequently, that firm has more than trebled output of very high purity soda ash.

Currently, the West End division of Stauffer Chemical Co. is building a plant and contracting a mine shaft in its entry into the natural soda ash production in the region.

In early December, officials of Allied Chemical Co. visited the area to inspect exploration operations the firm is conducting. The Stauffer project is 21 miles northwest of Green River.

Wyoming's uranium production in 1960 set an all-time record with about a 25% increase over 1959, R. W. Beamer, secretary of the Wyoming Mining Assn., reports. He said the state's uranium mines produced about $50-million worth of yellow cake ore in the past year.

"We figure minerals produced from ores in this state to have been in excess of $75-million last year," Beamer said. Trona was one of the other top producing ores in 1960.

Colorado Fuel and Iron Co.'s iron ore mine at Sunrise resumed operations on a four day week schedule Jan. 16 after being idle since mid-December. About 250 men were idled by the month-long shutdown of the mine, caused by a large stockpile of iron ore at the company's blast furnace in Pueblo. The same situation existed during September.

IN CANADA

Canada's mineral production reached a record value of $2,471,742,000 in 1960, an increase of 2.6% over the preceding year's $2,409,021,000. Among major minerals there were increased values for nickel, copper, zinc, asbestos, gold, coal, crude petroleum, natural gas, platinum, and sand and gravel, and decreased values for iron ore, lead, uranium, cement, lime and stone. Metals as a group were valued at $1,399,489,000, an increase of 2.1% over the preceding year's $1,370,649,000.

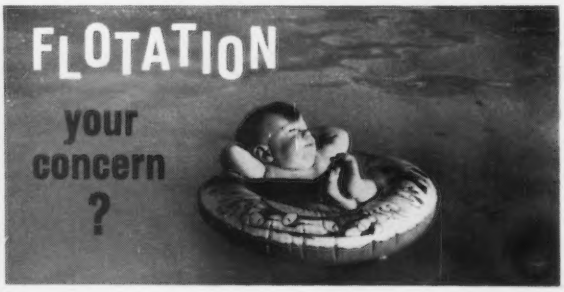
Canadian Mineral Production
(in 1000's of dollars)

Metals	1960	1959
Nickel	$312,738	$257,009
Copper	264,337	233,103
Uranium	262,935	331,143
Iron ore	171,671	192,666
Gold	156,172	150,508
Zinc	108,210	96,943
Lead	35,929	39,617
Silver	28,727	28,023
Platinum	18,135	11,015
Other	40,635	30,622
Total	$1,399,489	$1,370,649
Non-metals		
Asbestos	$118,701	$107,433
Salt	18,644	$8,035
Gypsum	9,308	8,394
Peat moss	5,851	6,227
Elemental sulphur	4,679	2,621
Other	37,677	35,767
Total	$194,860	$178,217

BRITISH COLUMBIA

High level of mineral exploration and development in British Columbia during 1960, plus concrete plans for future activity makes mining the current bright spot in the B.C. economy according to reports by the B.C. and Yukon Chamber of Mines.

The chamber's positive attitude was reflected in the B.C. Department of



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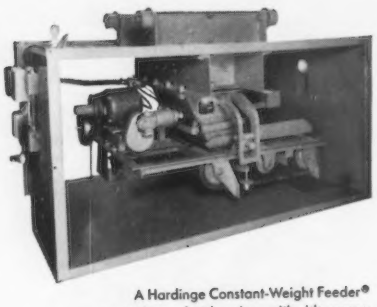
IMPROVED PRODUCTION
... look to Hardinge !

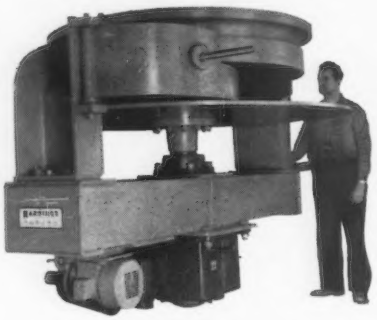
HARDINGE FEEDERS

Hardinge Feeders are available in sizes and types to meet your specific requirements. Constant-Weight Feeders, Volumetric Belt Feeders, Disc Feeders and Rotary Pocket Feeders are offered. All Hardinge Feeders are suspended from feed bins or tracks and need little head room. Costly feeder support structures are unnecessary; equipment following the feeder is readily accessible. When track-mounted, one Hardinge Feeder may serve a number of bins, intermittently.

For the Hardinge Feeder story, with drawings, photos and detailed specifications, ask for 12-page bulletin No. 33-E-1.

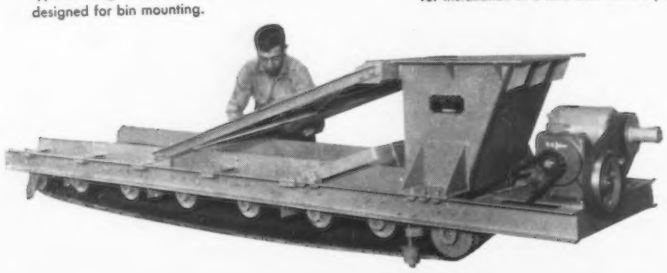


A Hardinge Constant-Weight Feeder® mounted in a dust housing, with side covers removed. Observation windows are provided in covers. Note track-mounting wheels at top.



84-inch diameter Hardinge Disc Feeder for installation in a lime and cement plant.

Extra-long (96 inch) conveyor type Hardinge Volumetric Belt Feeder designed for bin mounting.



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Main Office and Works • 240 Arch St., York, Pa.
"Hardinge Equipment—Built Better to Last Longer."

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BIRMINGHAM

B. C. *(Continued)*

Mines' preliminary report for 1960, which showed production 17% greater than 1959—the highest value since 1956, the record year. The 1960 value was given as $175,300,000 compared to the 1956 total of $190,084,000.

It was estimated that in 1961 the mining industry will spend $40-million in the Vancouver area on equipment, supplies and wages. This is mainly due to such activities as iron ore developments on the coast, Craigmont Mines' 4000-tpd production program at its Merritt property, and other projects.

During 1960, 50 large companies were active in the northwest, including B.C., Yukon and Northwest Territories. With more than 500 prospectors in the field, helicoptor and other charter aircraft companies have been booked to capacity all year, and they look for more business in 1961.

Iron ore mining was given a boost by a revision of BC regulations which eased the tax burden. The iron mines now operating are mining around 7000 tpd. They are Texada Mines Ltd., Empire Development and Nimpkish Lake. Early in 1961 International Iron at Zeballos is expected to add 3200 tpd to the total. Other promising iron properties have been, or are being, explored at Harriet and Tasu harbors on the Queen Charlotte Islands, on the Wedeene River near Kitimat, and on southern Vancouver Island at Kennedy Lake and Port Renfrew, according to the government report.

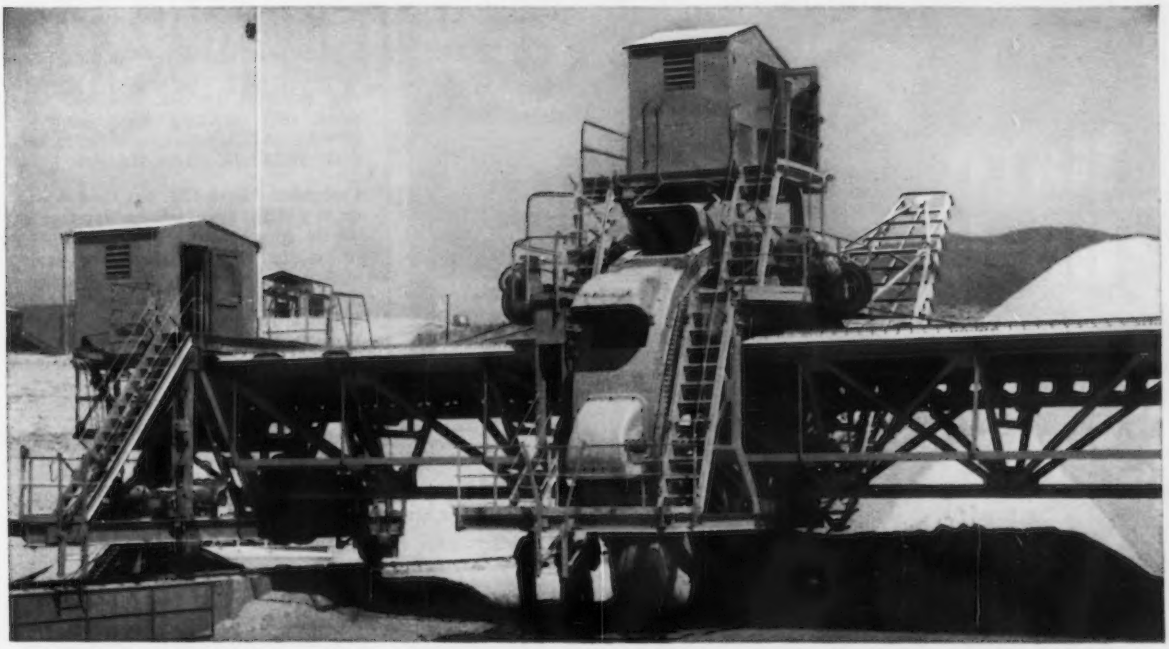
Japan is the sole customer for iron ore and that country's interest in base metals has been a big spur to the industry. Japan is also buying copper and nickel, and has provided considerable financing. Bethlehem Copper Corp., with Japanese backing, is moving towards production, and the Giant Nickel Ltd. mine at Hope has been shipping to Japan since March.

There has been a growing interest in gold properties and many companies have staked or investigated showings.

The first iron smelter in the province at Kimberley, near the Sullivan Mine of the Consolidated Mining & Smelting Co. Ltd., will use the large reserves of iron sulphide recovered as tailings from Sullivan ores. These reserves, which are added to each year, will be sufficient for its basic needs for many years. The smelter is expected to commence production late in 1961.

Milling capacity of the plant for asbestos at Cassiar has been increased from 1000 to 1500 tpd. The past year has been the most productive to date, with substantial increases both in tonnage treated and sales value.

The 1960 estimates with 1959 final figures in brackets are: gold, $7-million ($6,021,484); silver $6.2-million ($5,420,593); copper, $9.1-million ($4,497,991; lead, $33.5-million ($33,542,306); zinc, $51-million ($44,169,198); iron plus nickel, $13.5-million ($7,106,920); by-product metals, including antimony, bismuth, cadmium, indium, and tin, $4.7-million ($4,317,214); industrial minerals, including asbestos, sulphur,



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It blends... it reclaims... it ends inefficiencies of selective mining

As part of a new H-R Rotary Bucket Wheel Blending and Reclaiming System, this giant 3-story wheel is capable of processing efficiently a broad range of materials . . . especially where more than one of the following typical situations exist:

1. Engaged in selective mining
2. Unable to comply with specifications
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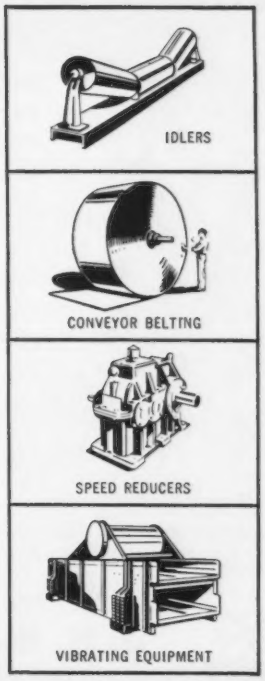
4. Storage pile requirements range 50,000 tons and over
5. Two or more types of raw material to blend for chemical compounding.

For full details consult your H-R representative, or write Hewitt-Robins, Stamford, Connecticut. Ask for Bulletin 2-16



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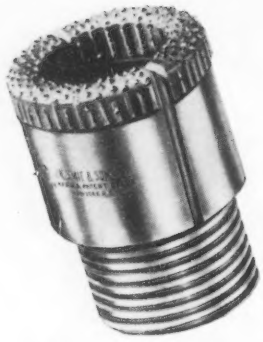

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Few things vary as much in quality as industrial diamonds. No one knows this better than J. K. Smit & Sons, Inc., where a veteran staff of specialists select the diamonds that give J.K.S. Diamond Drill Bits their exceptional cutting properties and long life.

Many of these men, and their fathers before them, have spent their lives with J. K. Smit as diamond experts. Theirs is one of the rarest skills in the world . . . a skill that makes a continuous contribution to the worldwide reputation of J.K.S. Diamond Drill Bits for giving more footage in every type of formation at lowest costs.

Send today for J.K.S. Catalog #60, or see your nearest field representative.

First In Experience and Service

J. K. Smit & Sons, Inc.

Home Office and Plant

Murray Hill New Jersey

B. C. (*Continued*)

gypsum and others, $16.5-million ($14,028,055); structural material including clay products, cement, lime and limestone, rock, building stone, sand and gravel, $17.6-million ($19,025,209); coal, $6.25-million ($5,472,064).

Craigmont Mines Ltd. has started work on a $18.5-million mining development on its copper-iron property near Merritt in the Nicola Valley. The project includes a $3.5-million mill which will handle 4000 tpd of ore and employ 250 men. Target date for production start is November 1961. Craigmont Mines comprises Canadian Exploration Ltd., chief shareholder; Peerless Oil & Gas Co. and Noranda Mines Ltd.

International Iron Mines has signed a contract with Japanese interests for 3-million tons of iron ore, worth an estimated $30-million, Alfred H. Upton, president, reports.

International will ship 500,000 tons of beneficiated ore annually from its Zeballos open pit on Vancouver Island. A dock, crushing plant, power and beneficiation plant worth $1.2-million will be built at Zeballos immediately.

Coast Copper Co. has signed a five-year contract with Mitsubishi Metal Mining Co. and Dowa Mining Co. that is expected to gross $18,750,000, according to Trader's Chronicle Metal News of Tokyo. Coast Copper is controlled by Consolidated Mining & Smelting Company of Trail.

The concentrate (26% copper) is to be imported into Japan at the rate of 25,000 tpy starting, in 1962. To bring the property into production. Mitsubishi and Dowa will advance $500,000 to Coast against the ore that will be imported. Coast is expected to operate at a rate of 750 tpd.

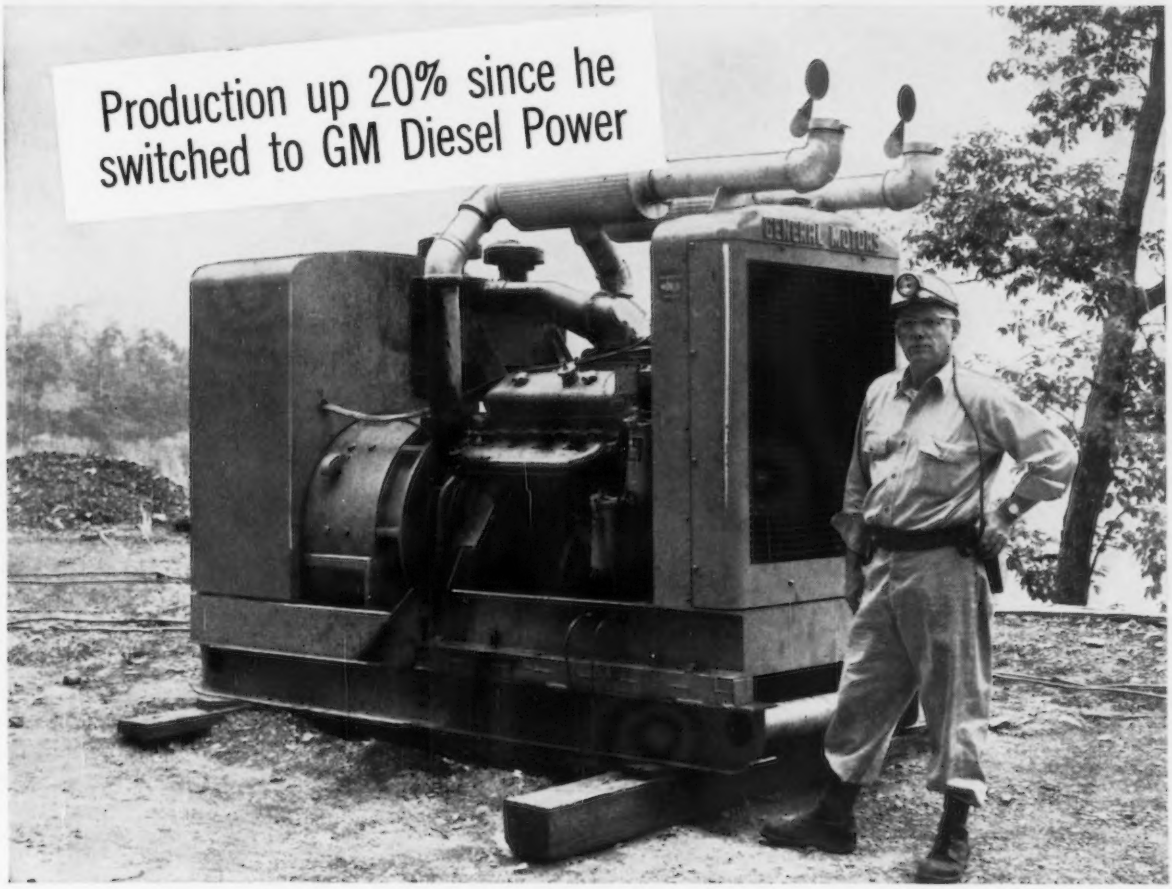
ONTARIO

A late fall gold-silver discovery in the Fort Hope area, some 100 miles north of Nakina, touched off a staking rush along a 19-mile belt, resulting in the staking of more than 600 claims. The discovery was made by prospectors working for the Little Long Lac organization. Crews are now in the area to carry out detailed prospecting. More than a dozen companies have picked up ground along the belt.

Rio Algom Mines has embarked on a shaft deepening program at its Algom Nordic uranium mine in the Elliot Lake area. The shaft is being taken down another 400 ft to around 1700-ft depth to provide an additional four levels. This work will open sufficient ore to enable operations to continue until contract obligations to Eldorado are completed sometime in 1965.

Full capacity operations were resumed recently at the Marmora area iron operation of Marmoraton Mining Co., Canadian subsidiary of the Bethlehem Steel Corp. The mine was shut down for a

GET REAL PRODUCTIVITY—GET A GM DIESEL



Production up 50 tons per day with no increase in fuel consumption.

Equipment slowdown because of sudden load increases ended—electric-motor overloading eliminated—downtime and equipment repairs cut...

That's what happened at Phillips Coal Company's Reedy Creek Operation in Pineville, W. Va., when they switched from a competitive Diesel to an 8V-71 "Jimmy."

The "8V-71" runs a 150 KW generator—furnishes all the power needed by a #512 hydraulic coal cutting machine, #14BU Joy loader, two 6SC Joy shuttle cars, belt line, chain line, and 5-foot ventilating fan. There's reserve power for additional equipment if it's needed, too.

Reedy Creek Owner-Manager Leonard Phillips says he picked a GM Diesel because of the job other "Jimmys" have done for him since 1954. He operates a Koehring shovel and two auger drills, powered by "4-71" GM Diesels—reports he's averaging four years between engine overhauls.

If you want to make more money from your mine, put a GM Diesel to work for you. See your GM Diesel Distributor for details. He's part of a coast-to-coast network of "engine people" you'll find in the Yellow Pages under "Engines, Diesels."

GM DIESEL

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Ni-Hard liners keep their contour after grinding better than 2 million tons of ore

Here's photographic proof from the Benson Mine, New York Ore Division of Jones & Laughlin Steel Corporation in upstate New York.

Ni-Hard liners keep their contour — resist abrasion — provide a slow, uniform wear rate — are good to the last ¼ inch.

You could never tell by looking at them, but these Ni-Hard* nickel-chromium-iron alloy shell liners have been grinding iron ore *for more than 2 years.* With better than 2 million tons of ore behind them, they've still got plenty of tonnage left in them!

Used in J&L's ball mills and rod mills —at the feed end as well as the discharge end—these Ni-Hard liners are delivering *superior abrasion and wear resistance.* They're saving many thousands of hours of downtime, many thousands of dollars in repair and replacement.

Try a set of Ni-Hard liners and see for yourself how the abrasion and wear resistance of Ni-Hard can increase *your* tonnage, can lower *your* costs.

Our detailed 58-page booklet, "Engineering Properties and Applications of Ni-Hard" suggests many ways to put this versatile and long-lasting material to work profitably. Say the word and we'll be glad to send you a copy.

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THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street INCO New York 5, N. Y.

NI-HARD®

NICKEL MAKES CASTINGS PERFORM BETTER LONGER

Ontario (*Continued*)

period of six weeks from Oct. 1 to Nov. 14, 1960, due to sharp decline in U.S. steel production. Iron pellet production in 1960 was anticipated at about 400,000 tons or some 80% of capacity. Production is being stockpiled at Picton for shipment to the Lackawana steel plant in the spring.

Great Whale Iron Mines Ltd. will begin feasibility studies for marketing concentrates from its three major magnetite deposits in Northern Ontario this year as a result of a report by U.S. mining geologist and iron specialist Lloyd M. Scofield.

Walter Maybank, explorations director for Little Long Lac Gold Mines Ltd., parent company of Great Whale, said Scofield's report of Great Whale's holdings, 675 miles north of Montreal and 45 miles inland from the east shore of Hudson Bay on the Great Whale river, contained these findings:

Three deposits containing an estimated 942-million long tons of concentrating ore recoverable by open-pit mining;

These deposits are capable of yielding 383-million tons of iron concentrates containing 67.1% iron and 5.5% silica for a concentration ratio of 2.45:1;

With an average grind of 85% minus 200 mesh required to liberate the concentrates, power required is 19.5 kwh per long ton.

QUEBEC

Quebec Lithium has moved into a new field with the bringing into production of its chemical plant adjacent to its lithium mine and mill near Val d'Or. The plant, at capacity, will be able to produce at the rate of 500,000 lbs of lithium carbonate a month. In addition it will be able to turn out lithium hydroxide, but output of this product is being deferred to a later date. The refinery was started up last October but it has not been on steady operation until recently. The company also produces ceramic and chemical grade lithium concentrates, which are being sold under contract to customers in Canada and the U.S.

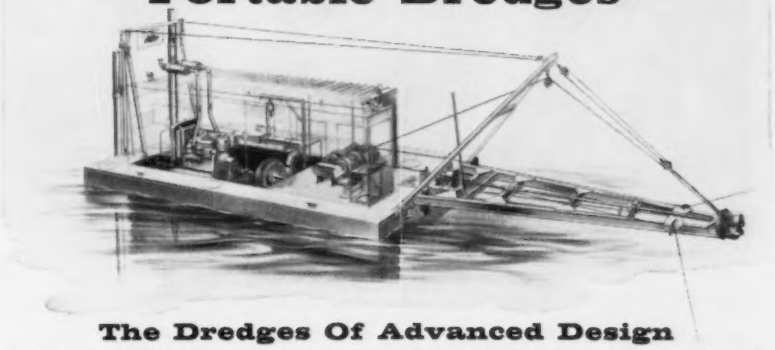
Murray Mining Corp. has outlined sufficient additional tonnage on its Ungava area asbestos property to justify minimum production of 2000 to 2500 tpd. Field manager J. T. McQuat estimates 11,681,260 tons grading $18.59 per ton has been indicated by drilling, with an additional 3,901,744 tons grading $17.81 per ton inferred. Cut-off grade is $10 per ton. The deposit is still open at both ends and at depth.

The provincial government of Quebec has reversed its mining exploration policy in the opening of the vast New Quebec area to independent prospectors and developers. Since 1955 the Quebec government closed this district to staking and granted instead exploration licenses covering large areas. Exploration licenses presently in force will not be affected and in addition three concessions in the Wakeham Bay-Cape Smith belt are to be put up for auction. Approximately 15,000 sq miles has been released plus an additional 4400 sq miles further to the east, which was withdrawn from staking in 1956.

East Malartic Mines is expected to complete internal shaft sinking early this spring at its Malartic area gold producing mine. The 4-compartment opening extends from the 23rd level and is to go to the 4845-ft horizon to permit opening of seven new levels. First work is slated tentatively to be carried out on three levels, the 25th, 26th, and 30th. The shaft, 1850 ft east and some 200 ft south of the main No. 4 incline shaft, will permit exploration of the downward extension of the main ore structure.

Decision has been made to bring the Orchan Mines' Mettagami Lake zinc-copper property into production at a 1000-tpd rate. The mill is expected to be in operation by 1962. In addition, the company anticipates that it will participate with other Eastern Canadian mining companies in the construction of a zinc refinery to serve the area. Financing for production is being advanced by Noranda Mines, which holds a substantial share interest. Indicated ore reserves are estimated as sufficient to support the 1000-tpd mill rate for 12 years.

Ellicott "Dragon"® Model Portable Dredges



The Dredges Of Advanced Design Whose Performance Is Proved Not Promised

Here are some of the reasons:

1. These are dredges in which portability is a reality not a possibility. *Patented* 2-piece hull disassembles quickly and can be reassembled on shore or in the water.
2. All components designed and built by Ellicott whose centralized engineering and manufacturing responsibility insures quality control.
3. Products of experience gained by a company which has concentrated on designing and building dredges of all sizes and types for 75 years. *This "know-how" is unequalled by any other dredge builder.*
4. "DRAGONS" are completely electro-hydraulically operated with unified controls to facilitate handling ease, lessen operator fatigue and raise outputs. *This kind of control was introduced by Ellicott on portable dredges over 10 years ago.*
5. All precision machinery easily accessible for servicing. Eliminates costly delay in maintenance of vital operating components.
6. "DRAGONS" which comprise over half of Ellicott's total dredge production are working throughout the world on road construction, land reclamation, industrial anti-pollution and waterway maintenance programs. These are only a small sampling of the projects on which "DRAGON" versatility has been demonstrated.

For further information on the certain efficiency and the economy of "DRAGONS" and what satisfied users have said about them, send for Bulletin 980. Just fill in the handy coupon.

2755.

ELLICOTT DREDGES

ELLICOTT MACHINE CORPORATION, Baltimore 30, Maryland, U.S.A.; Ellicott-Brandt, Inc., Baltimore, Maryland; Ellicott Fabricators, Inc., Baltimore, Md.; McConway & Torley Corp., Pittsburgh, Pa.; Timberland-Ellicott, Limited, Woodstock, Ontario, Canada; Dragues Ellicott France, Paris, France; Dragas Ellicott do Brasil Ltda., Rio de Janeiro, Brazil; Ellicott de Mexico, Mexico City, Mexico.

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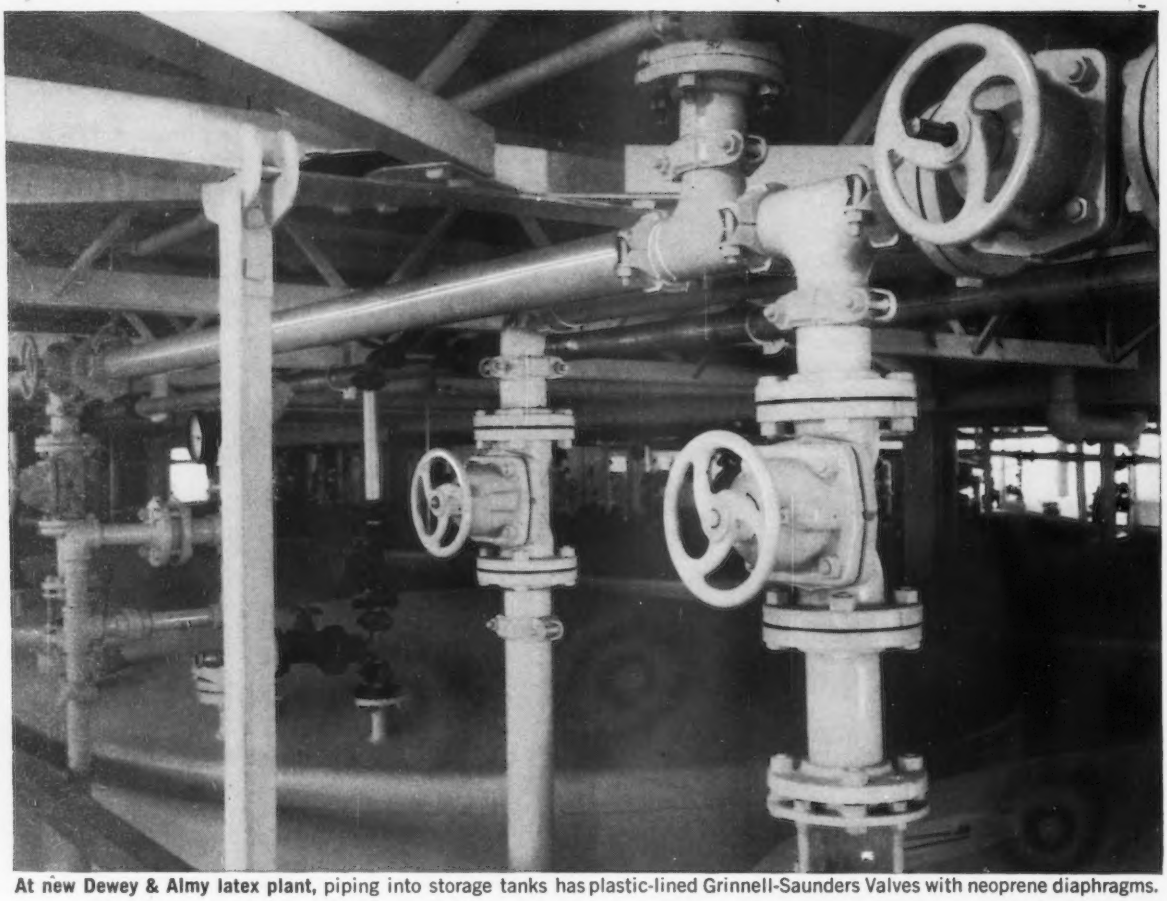


At new Dewey & Almy latex plant, piping into storage tanks has plastic-lined Grinnell-Saunders Valves with neoprene diaphragms.

At Dewey & Almy plant . . .

Grinnell-Saunders Diaphragm Valves guard against plugging, corrosion, contamination

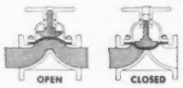
The new Owensboro, Kentucky plant of Dewey and Almy Chemical Division, W. R. Grace & Co., makes polyvinyl acetate emulsions and butadiene-styrene co-polymers for adhesives, paper coatings, emulsion paints and other products.

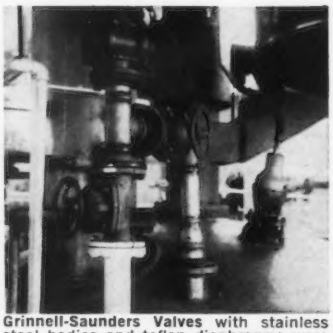
These co-polymers present several manufacturing problems: build-up of obstructions that plug lines, high viscosity that needs wide-open lines, easy hardening by the air.

Selected to handle this tough job: *Grinnell-Saunders Diaphragm Valves.* These rugged valves have a diaphragm that lifts high for streamline flow; seals tight for positive closure. Bonnet mechanism is completely isolated from material in the line by the diaphragm to prevent corrosion and contamination.

What's more, Grinnell-Saunders Diaphragm Valves give smooth passage of material . . . eliminate trapping of solids, reduce frictional resistance. You can choose from a number of body, lining and diaphragm materials.

Find out how Grinnell-Saunders Diaphragm Valves can help *your* installation. Write Grinnell Company, Providence 1, R. I.





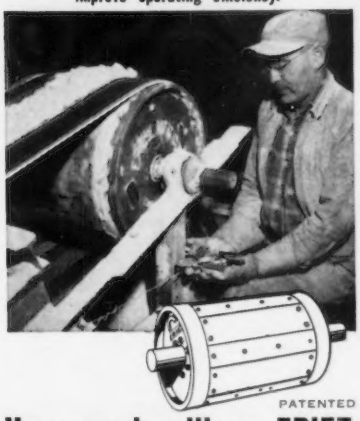
Grinnell-Saunders Valves with stainless steel bodies and teflon diaphragms were specified for the reflux lines of this co-polymer reactor.

GRINNELL-SAUNDERS DIAPHRAGM VALVES

GRINNELL COMPANY, PROVIDENCE 1, R. I. • BRANCH WAREHOUSES AND DISTRIBUTORS FROM COAST TO COAST
PIPE FITTINGS • VALVES • PIPE HANGERS • PREFABRICATED PIPING • UNIT HEATERS • PIPING SPECIALTIES

ERIEZ Magnetic Minute

60 seconds that will help you improve operating efficiency.



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How much will an ERIEZ PERMANENT MAGNETIC PULLEY save you?

Erium® powered Eriez magnetic pulleys save one firm $1200 a year by removing 50 pounds of tramp iron a week from coarse clay. They can save you as much—or more, depending on your application.

In addition to preventing machinery damage, Eriez permanent magnetic pulleys prevent fires and explosions; assure product quality.

The pulley illustrated is one of 192 sizes (up to 36" diameter in any belt width) made by Eriez. **There is one for your exact application.** Two basic models are available: **Type AA,** ideal for separating small and medium tramp iron and fine ferrous contamination; **Type CR,** which performs best in removing large pieces of tramp iron.

All models are engineered and constructed to give you the finest in automatic separation. All are powered by Erium®—our exclusively-designed power source. Model for model, Eriez units give you the finest quality and consistency of magnetic strength.

For descriptive bulletin write to:

ERIEZ MANUFACTURING CO.
146PA Magnet Drive, Erie, Pa.

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We willingly share our design and application know-how to help our customers find new ways to improve their plant efficiency and product quality.

E. J. TENPAS
Supervisor,
Magnetic Engineering

ERIEZ

A GROWTH COMPANY . . .
10 NEW PRODUCTS IN THE LAST 5 YEARS

Quebec *(Continued)*

Coniagas Mines is expected to turn over the 350-tpd mill at its Bachelor Lake zinc-lead-silver property early in March. In the meantime, underground development is progressing on five levels. As previously indicated, ore reserves are estimated at 407,310 tons to the 625-ft level averaging 15.7% Zn, 1.04% Pb and 8.77 oz Ag per ton with an additional 60,000 tons of probable ore indicated in drilling below this level. This is confined to only one sector of the main zone, which is indicated to extend right across the property.

IN AUSTRALIA

The Western Australian Govt. has approved the granting of three mineral reserves for vanadium mining to Mangore (Australia) Pty. Ltd., a subsidiary of Union Carbide Corp. Total area involved is 23,400 sq miles and the biggest one is an 18,000 sq mile block between Meekatharra and Norseman.

Electrolytic Zinc Industries Ltd. has begun the first stage of extensions to its Risdon (Tasmania) plant aiming at zinc production increase to 140,000 tpy. Cost of extensions is $4.5-million. A plant is also being installed to recover zinc from a dump of zinc plant residues containing 465,000 tons with 20% Zn content and some Ag, Pb and Cd values.

The Fijian government decided not to extend its subsidy to gold producer, Emperor Mines Ltd., beyond its present agreement. Underground prospects appear to be very encouraging but narrow orebodies require large capital expenditure.

IN INDIA

The Indian government has decided to put up a smelter to produce 400 tpd sulphur from the sulphur pyrite ore discovered in the Amjore district of Bihar state, East India.

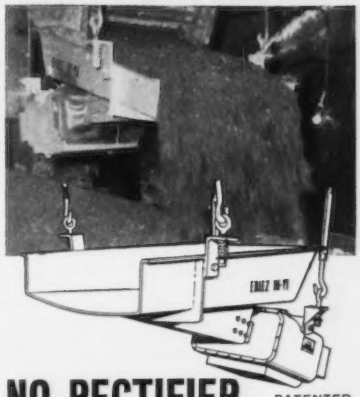
The project, estimated to cost around $16-million, will be state-owned and the contract for plant and machinery is likely to go to a Norwegian firm, although no final decision has yet been taken on this. The smelter is proposed to be set up before 1963 with production slated to begin early in 1964.

At present, India imports an annual 300,000 tons of sulphur; the estimated demand by 1965-66 is likely to be around 600,000 tons with half this amount planned to be met from local production.

A proposed Rumanian-Indian pact envisages progressive exports of iron ore to Rumania touching a million tpy by 1970. In a ten-year agreement, being drafted, India in turn will receive petroleum products and oil exploration equipment. India will also stipulate that the agreement will not affect normal trade between the two countries.

ERIEZ Magnetic Minute

60 seconds that will help you improve operating efficiency.



NO RECTIFIER NEEDED WITH ERIEZ HEAVY-DUTY VIBRATORY FEEDERS

PATENTED

AC powered Eriez Hi-Vi vibratory feeders move large tonnages of bulk materials with accurate control . . . more efficiently and economically. Illustration shows one of a number of Eriez units available for heavy feeding applications where **big capacity and accuracy** are essential.

Whatever your application, there is an Eriez electro-permanent magnetic feeder that will meet your exact needs. And you get this exclusive combination of advantages: No rectifier needed . . . AC operation. Totally enclosed drive element ideal for hazardous, dusty, wet and corrosive installations. New fibre glass springs assure superior performance and control . . . longer life because spring breakage is practically eliminated.

The full line of Eriez Hi-Vi vibratory feeders includes models with feeding capacities ranging from ounces to many tons per hours.

Write for descriptive bulletin to:

ERIEZ MANUFACTURING CO.
146PB Magnet Drive, Erie, Pa.

MAGNA-THOUGHT

Constant research, development and refinement are the keys to new and improved products. New and improved products are the keys to a company's growth.

A. F. ISRAELSON
Chief Engineer

ERIEZ

A GROWTH COMPANY . . .
10 NEW PRODUCTS IN THE LAST 5 YEARS

PHILIPPINES

A new revised emergency assistance plan for the gold mining industry was approved by the Monetary Board early in December to aid the gold producers to withstand the lower price for gold in the open market that was induced by recent monetary decontrol moves by the Government. The present open market price is about 128 pesos an oz, compared with 150 pesos earlier in the year. Producers are now allowed to bring in all needed supplies at the preferred rate of 2.4 pesos to the dollar instead of 50% at the free market rate and 50% at the preferred rate. Gold producers will be permitted to retain 90% of the dollar proceeds of their sales to the Central Bank.

Benguet Consolidated, largest Philippine gold producer, had an output of 195,253 oz of gold during the January-October period of last year. In October the company milled 109,000 tons of ore and recovered 20,000 oz of gold. Lepanto Consolidated produced 2,572,000 lb of copper and 4156 oz of gold from milling 40,250 tons of ore in November. The company declared its regularly quarterly dividend in December, making a total of 4 centavos per share for the year.

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Two officials of Surigao Consolidated have been in Tokyo negotiating with the Japanese firm of Itoh & Co. for financing, operating, and purchasing ore from two of its mining properties, the Pioneer iron ore area and the Lluck copper area. Both are located in Zamboango del Sur. Sufficient ore has been uncovered in the Pioneer property to interest Japanese steel mills. The Japanese firm has asked for priority in any negotiations for sale of the copper.

IN AFRICA

The mining year in South Africa has been marked by exceptional activity in the exploration field. Nearly every mining house is looking for gold prospects in the Transvaal and Orange Free State. There is also a certain amount of prospecting in the Rustenburg area of the Northern Transvaal but the target is likely to be some mineral other than gold. Rustenburg is the Union's platinum producing area.

With a production of about 21,400,000 oz, the gold-mining industry has had its best year ever. The value of its product is estimated at about £267,000,000 ($747,600,000). During the year, the mining industry applied continuously improving scientific methods to the development of the new mines and succeeded in smashing the world high-speed shaft-sinking record by a wide margin on the Anglo-Transvaal mine at Hartebeestfontein. Six potential mines were pushed nearer to the production stage and new mines west of Johannesburg and in the Orange Free State increased their output. Gold production from the Orange Free State rose to 6,339,000 oz vs. 5,582,000 oz in 1959.

South Africa

1960 production figures (est.)

Gold	21,400,000 oz
Silver	2,211,711 oz
Diamonds	3,055,576 carats
Antimony	21,000 tons
Asbestos:	
Amosite	70,000 tons
Chrysotile	28,950 tons
Other	75,900 tons
Chrome	863,833 tons
Copper	53,560 tons
Iron ore	3,197,600 tons
Manganese	1,280,350 tons
Tin	3,300 tons
Titanium	95,000 tons
Zircon	7,240 tons

South-West Africa (est.)

Beryl	242 tons
Copper ore	4,785 tons
Lead-copper-zinc concentrates	221,700 tons
Lead-vanadium concentrates	8,522 tons
Lithium ores	4,850 tons
Diamonds	918,500 carats

The biggest tunneling job in South African history, at the Loraine gold mine in the Orange Free State, covered a distance of more than 21,000 ft. It was driven in both the haulage and com-

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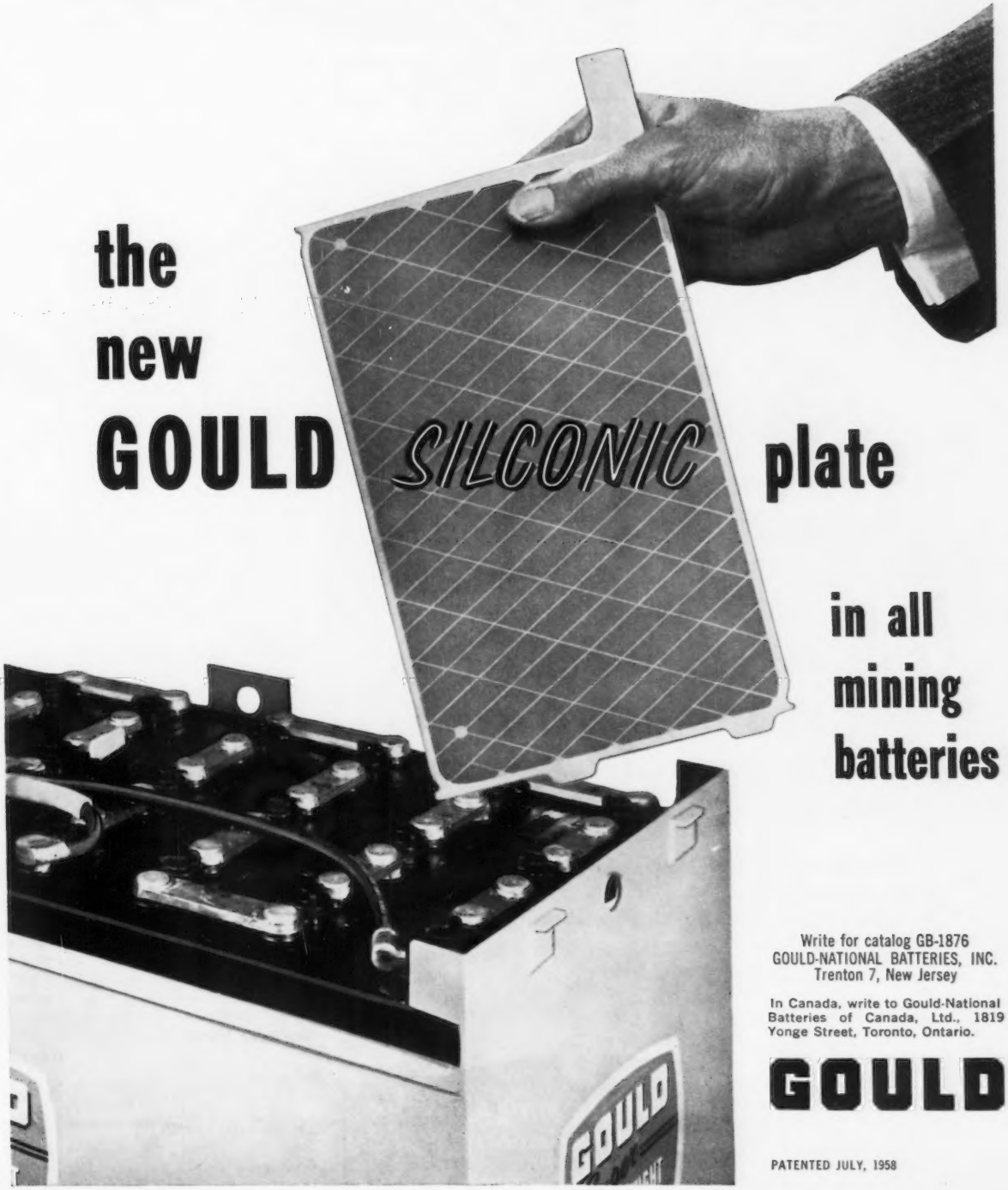

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Africa (*Continued*)

panion airway between No. 2 and No. 3 shafts.

The work went on at a depth of more than 5000 ft with rock temperatures about 110°F and was completed in June 1960.

The quarterly report issued by the Hartebeestfontein Gold Mine—an Anglo-Transvaal property in the Western Transvaal—gives the depth of No. 4 Shaft at December 31, 1960 as 3639 ft. The depth of the shaft on the morning of Jan. 10, 1961 was 3909 ft. This latter date represents the end of the 100-day period which started on Oct. 1 but which excluded Christmas Day which was a non-working day. During this 100-day period, the shaft was deepened by 3, 110 ft—an average of 31.1 ft a day. This is the fastest rate of sinking ever achieved over a sustained period anywhere in the world.

Kennecott Copper Corp. has sold its interest in two South African gold mines—the Virginia Orange Free State Gold Mining Co. and the Merriespruit, Orange Free State, Gold Mining Co. The purchaser is a South African company formed by a syndicate headed by Charles W. Engelhard, Chairman of Rand Mines.

Kennecott is to receive £3.5-million (about $10-million) in five equal annual installments starting Dec. 7, 1961, together with a 20% interest in any net income and capital gains of the purchasing company, limited to a maximum of £2.5-million.

Kennecott's total investment in the two mines has amounted to approximately $46-million, including debenture and loan stock, and it has received interest and redemption payments approximating $3,914,000.

Production at Merriespruit began in March 1956, but in the following November the mine was flooded by an inrush of water, the volume of which was unprecedented in the history of South African mining. In October 1959, because of the disappointing gold values and rising level of costs, stockholders were advised that raising the additional capital needed to put the Merriespruit mine back in operation would not be justified.

Political disturbances and the uncertainty which prevailed in Central Africa during 1960 had little direct effect on the mineral mining industry of the two Rhodesias, and output records were broken by a number of mines.

The two large copper mining groups —Rhodesian Anglo American Ltd., and the Rhodesian Selection Trust—both reported highly successful results.

At the end of the financial year, on June 30, Anglo American showed a profit of $19,975,200. This was only $672,000 less than the record profit earned in 1955-56, when the average price of copper was $1,039 a ton compared with an average price during 1959-60 of $694 a ton.

In the group, Rhokana Corp.'s production was 103,981 tons and its profit $32.2-million. Nchanga Consolidated Copper Mines' output was 178,000 tons, with profits after tax of $38.08-million. Bancroft Mines, in its first full year of operations since the mine re-opened, produced 51,000 tons with a profit of $10.08-million.

Details of minerals produced are as follows:

Rhodesian Mineral Production
First 10 months, 1960

Northern Rhodesia

Mineral	Amount produced (tons)
Copper blister	155,000
Copper electrolytic	377,000
Zinc	30,000
Lead	10,000
Manganese	54,000
Cobalt	n. a.
Other copper	n. a.

Southern Rhodesia

	(tons)
Asbestos	111,000
Gold	467,000 (fine oz.)
Chrome ore	560,000
Coal	3,280,000
Copper	n. a.
Other copper	n. a.

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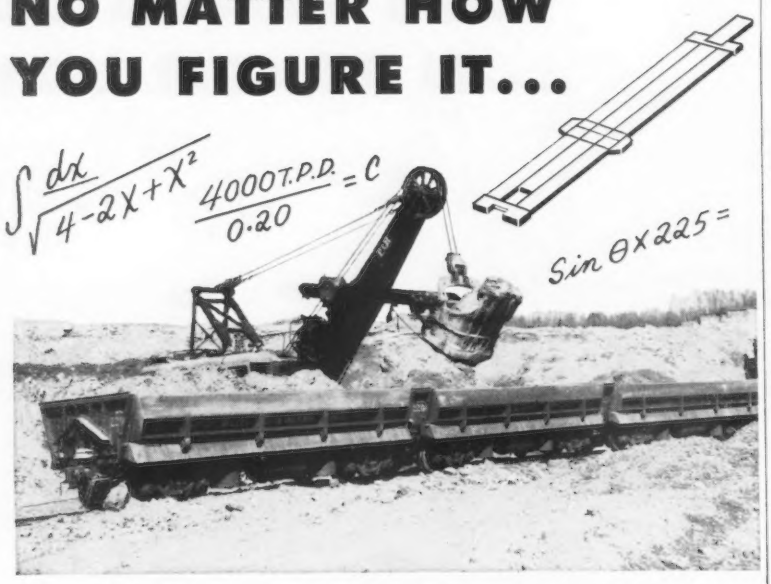

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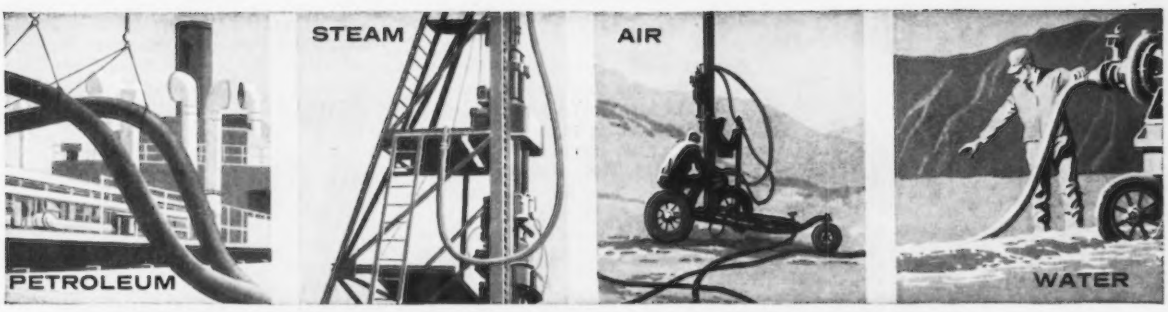

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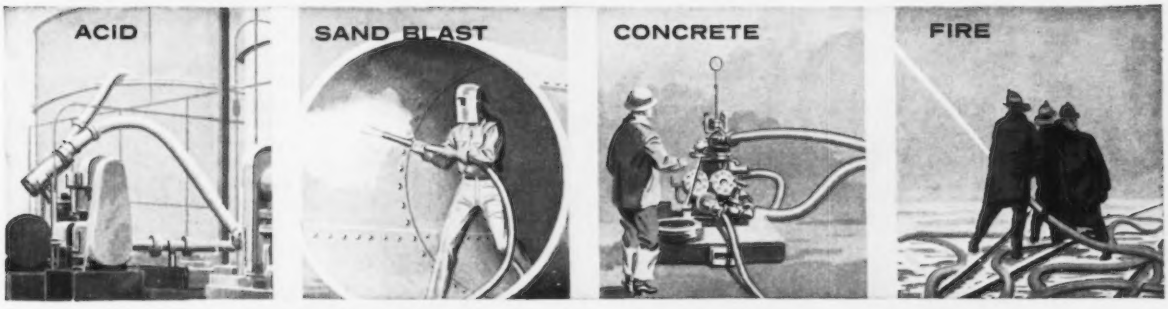

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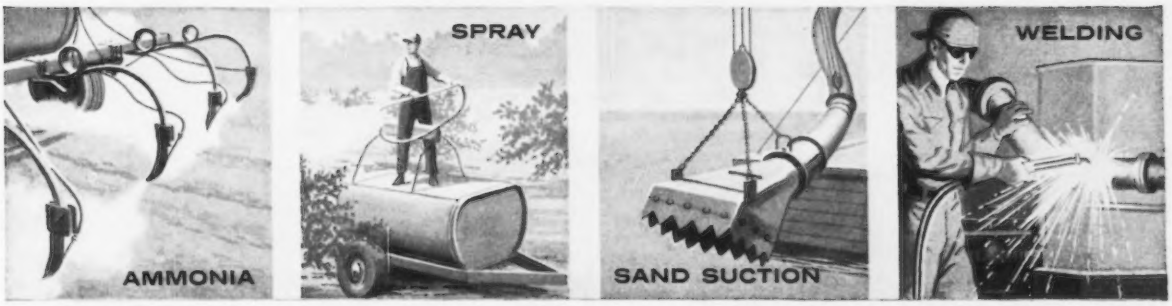

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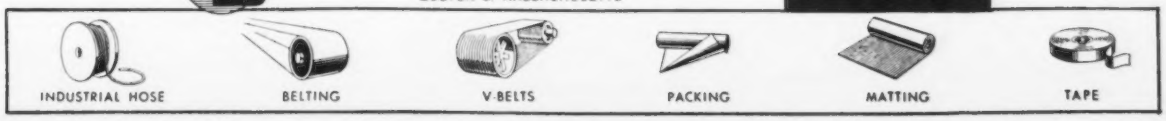

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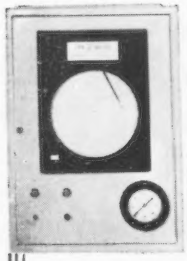

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Africa *(Continued)*

Production of copper from RST's three mines during the year ending June 30 was the highest yet recorded. Output was 217,548 tons, of which 216,576 tons were sold for an aggregate sales value of $149,319,909. There was a total profit of about $56-million before making reserves or allowing for taxation.

For the first 10 months of 1960, zinc production in Northern Rhodesia was a steady 3000 tpm, and lead 1000 tpm. In Southern Rhodesia, asbestos production ranged from 10,000 to 12,000 tpm; gold from 45,000 to 49,000 fine oz a month; chrome ore from 51,000 to 63,000 tpm; and coal from 303,000 to 348,000 tpm.

Value of all minerals produced in the Rhodesias in the first 10 months of 1960 was $369,768,000. The North produced $308,364,000 worth, and the South $61,404,000 worth.

Northern Rhodesia's Mufulira will be the second largest underground copper mine in the world when Mufulira West opens next year.

The development scheme is costing $44.8-million, and it will ultimately raise Mufulira's productive capacity by about 50% early in 1962. Only the El Teniente mine in Chile will be bigger than Mufulira underground operations.

The new mine will mean the hoisting of about 200,000 more tpm of copper ore, and the production of more than 50,000 long tpy of copper.

Mufulira is the biggest profit-earner for Rhodesian Selection Trust in their Copperbelt interests.

The new western extensions entail large-scale new mine office and accommodation development; extensions to the concentrator and to the concentrators and smelter (where eight new bins will bring the total to 20); and a new 3000-acre lake which will be 4½ miles long.

African workers will have a new garden township with shops, churches and beer parlors, covered bicycle sheds and cocoa kitchens.

Work has started on extensions to the leaching plant at the Nchanga copper mine in Northern Rhodesia. This development will increase the capacity of the plant by about 1000 tpm. Depending on test work now in hand, further extensions designed to increase the capacity of the plant by another 1000 tpm may be started later.

IN EUROPE

Two large mercury reduction plants designed by Gordon I Gould Co., San Francisco, will go on stream later this year in Spain and Yugoslavia. Both are rotary kiln-type plants.

The Yugoslavian plant is now being constructed in Italy, and will go into service at the Idrija Mine. It will have a capacity of 250 metric tpd of ore, and will feature the largest single mercury furnace ever built, according to the designer.

A similar but smaller plant is being built at La Esperanza Mine near Mieres, in nothern Spain, for Astur-Belga De Minas, S. A. It will have a capacity of 150 metric tons per day.

AUSTRIA

Austria's 65 mining enterprises can look back to a generally favorable year 1960 —although Austria's basic weakness in nonferrous ores—lack of lead and copper ores—led again to grave disproportion in regard to existing processing capacity. The real sensation was the skyrocking output increases for graphite, which makes Austria the world's second (after South Korea) graphite producer. The graphite boom was caused by introduction of an entirely new blast furnace method for iron production replacing part of coke and silica with low-cost domestic graphite.

Total mining yield — ferrous, nonferrous ores and metals and minerals— was $54.9-million during the first half of 1960, to which the nationalized mining business contributed $26.8-million. Full-year figures are not yet available. The output value during the first year of 1959 was $47.6-million in Austria's recession year, $58.4-million value during first half of 1958.

Extraction of Ferrous, Non-Ferrous, Ores and Minerals

Commodity (metric tons)	Year 1959	10 Months 1960
Iron ore	3,382,776	**2,944,342**
Lead-zinc ore	193,956	**159,876**
Copper ore	162,600	**118,242**
Antimony ore	12,984	**12,595**
Magnesite	1,201,212	**1,361,864**
Bauxite	23,976	**19,466**
Graphite	62,088	**73,037**
Raw Kaolin	297,576	**266,878**
Raw talcum	51,228	**67,501**
Silica	61,920	**69,708**
Feldspar	3,504	**4,000**

USSR

Although there are gaping holes in information available to the outsider, official pronouncements indicate the Soviet mining industry will be able to meet the mineral requirements of the USSR's burgeoning economy as it moves into an increasingly complex industrial era.

By their own account, the Soviets are sitting on top of the world's largest deposits of iron ore, copper, lead, manganese, bauxite, nickel, mercury, mica and zinc. Considerable deposits also are reported of tin, chromium, cobalt, magnesium, tungsten, molybdenum, titanium, tantalum, antimony, beryllium, vanadium, bismuth, columbium and other metals, plus germanium and silicon.

Exploitation is apparently proceeding at a sufficiently rapid pace, over-all, to meet the requirements of the Seven Year Plan, which began with 1959. In the case of iron and manganese, the Soviets are talking in terms of export.

The Soviet Union is now in the third

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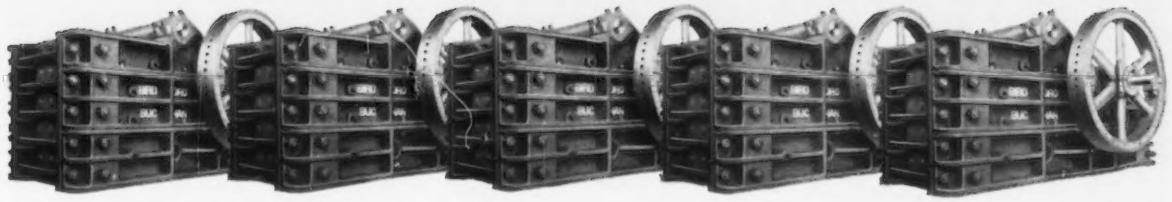

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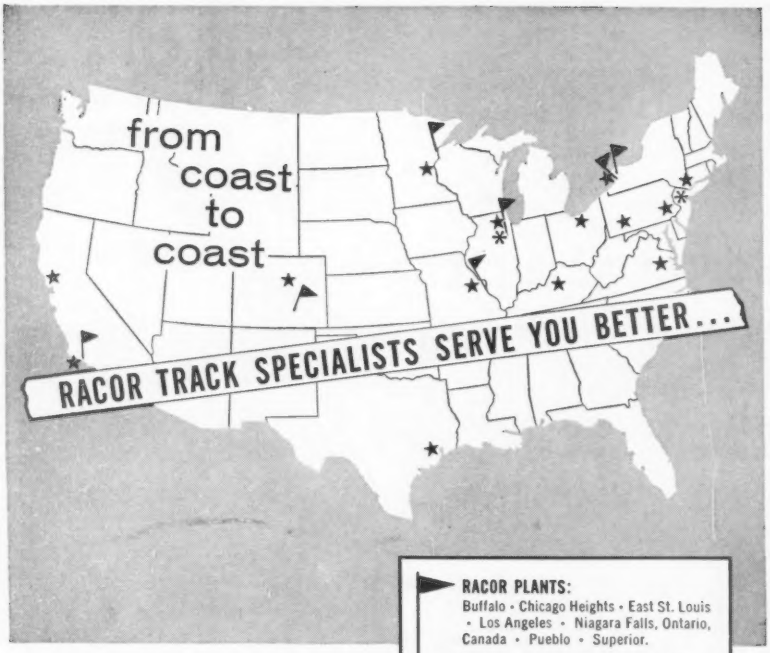

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USSR *(Continued)*

year of the Seven Year Plan. Little information is available on details of progress in the mining industry, particularly for non-ferrous and rare minerals. However, some indications are available from the recent meeting of the Supreme Soviet, and from other earlier announcements.

Extraction of iron ore, scheduled to increase from 88.8-million tons to 150 or 160-million tons during the Seven Year Plan, rose from 94.4-million tons in 1959 to some 105-million tons in 1960. Vladimir Novikov, chairman of Gosplan, claims 40-million tons of new capacity will be put into operation in 1961.

The plan calls for doubling output of refined copper and tripling production of aluminum by the end of 1965, but precise figures are not available.

The Soviets reported a year ago that the plan goals for nonferrous metals were fulfilled ahead of time.

"Increased" output of refined copper, aluminum, lead, zinc, tin, and nickel have been reported for 1960, but the economic bureaucrats have not seen fit to give the specifics.

The planners do say they are expecting a 15% increase in production of prime aluminum in the New Year, and a 9% step-up in production of refined copper along with a 14% increase for nickel.

Building an adequate metallurgical base has been, of course, one of the prime long-term goals of the Communists' Operation Bootstrap.

As they like to point out, the Czar's steel industry never produced much more than 4-million tons in a year, while the U. S. at that time was already producing 10 times that much. As late as 1932, Soviet steel production was still only 6-million tons.

P. Antropov, Minister of Minerals Conservation, says the Soviet Union now accounts for 41% of the world's total explored iron ore reserves, strategically scattered around the nation.

The world's largest iron ore reserves, says Antropov, are in the Kursk magnetic anomaly. Over 30-billion tons are said to await exploitation, more than a third of which are profitable for mining. The high-grade deposits have an iron content of 56% to 69% and, claims Antropov, need no enrichment before being processed.

Leaner iron quartzites in the anomaly are described as virtually limitless.

Production in the Kursk anomaly is currently some 7 to 7.5-million tons, and this is expected to rise to at least 15-million tons annually by 1965. The Soviets blame the late start in the Kursk anomaly—which has been known since 1784—on the fact that until recently mostly low-grade ores were known to be there in quantity.

Looking ahead, Antropov says as much as 60-million tons will be produced annually from the Kursk deposits by 1980—and he indicates an annual level of 36-million tons may be hit not long after 1965.

More rich reserves of iron ore are found in Kazakhstan. One big mining

USSR *(Continued)*

complex with an annual capacity of 26.5-million tons is under construction in the western part of the republic. Other important deposits have been found in central Kazakhstan.

Large iron ore deposits also are reported by the Soviets in the Krasnoyarsk area of Siberia, the Irkutsk region (with self-fluxing ores), the Chita region, the Kimkan and Garinsk ranges in the Soviet Far East, the Tayezhnoye range in southern Yakutia, and many other regions—including areas of old Russia.

Some 20-million tons of iron ore capacity are to be commissioned in 1961, for example, in the Ukraine.

With all these reserves at their disposal, the Soviets are concentrating on the deposits which are close to the surface—and therefore amenable to open-pit mining—and close to the "market".

At Sokolovka-Sarbai in Kazakhstan, where reserves have been estimated at 10-billion tons, what the Soviets call the world's largest open cut is planned. It is to produce, claim the Soviets, 38-million tpy. Power shovels will remove the overburden to a depth of 650 ft.

The first sections at Sokovoka-Sarbai, with capacities of some 6-million tons, already are in operation.

These deposits are to become the main iron ore base for ferrous metallurgy in the Soviet eastern areas.

The year 1961 will be a busy one for other segments of the Soviet mining industry, too.

Manganese. "The Soviet Union leads the world in the explored reserves of manganese ores," boasts Antropov. However, the chief of the USSR's mining industry complains that not enough high quality manganese ore has been found in the new eastern areas—the bulk of present reserves is in the Shiaturi and Nikopol ranges of the European USSR, and in the Tokmak field.

Manganese reserves at the Grushevskoe deposits alone run about 350-million tons, according to a recent TASS dispatch from Dnepropetrovsk. The latest of five mines put into operation there has an annual capacity of 250,000 tons. The Soviets call this the world's largest center of manganese ore production.

Aluminum. Antropov says large bauxite deposits have been discovered and prospected in Kazakhstan, Siberia and the Archangel region. But as he puts it:

"However, the accelerated development of the aluminum industry as envisaged under the Seven Year Plan cannot be based on the prospected resources of bauxites alone . . . aluminum-producing plants are usually located near powerful electric stations. But in spite of the big-scale exploration work carried out, no major high-grade bauxite deposits have as yet been found in many areas, especially Eastern Siberia, near cheap electric power sources."

However, Antropov says a good bauxite substitute—the nephelines—has been found in huge quantities in such widely scattered places as the Ukraine, the Urals, Transcaucasus, Central Asia and Kazakhstan.

The world's largest deposits of miascite—or nepheline rock—have been found in the Khibiny and Lovosersk tundras of the frigid Kola peninsula.

Of more immediate commerical importance, however, are the rich nepheline deposits in Krasnoyarsk territory and Kemerovo region which are to be developed on an industrial scale in the "nearest future," according to Antropov.

Diamonds. Although the exact extent of Soviet diamond reserves is unknown, they have been described as huge. It is perhaps significant that a Yakutian delegate to the Supreme Soviet pledged that his republic—where the big finds have been made—will increase the output of diamonds by 25 times during the Seven Year Plan, rather than only 16 times as previously planned.

Copper. The Soviets say copper pyrite reserves at the Gai deposits in the Urals are "second to none" in metal content, and are among the world's largest. Most of the Gai copper pyrites lie at a depth of 230 to 260 ft., and will be mined by the open-cast method.

Little information is available on other minerals.

The Soviets, for example, reveal almost nothing about their gold production—although the press did note recently that commercial extraction is now planned at a new find in Armenia.

TASS recently reported that scientists of the Soviet Far East are compiling a

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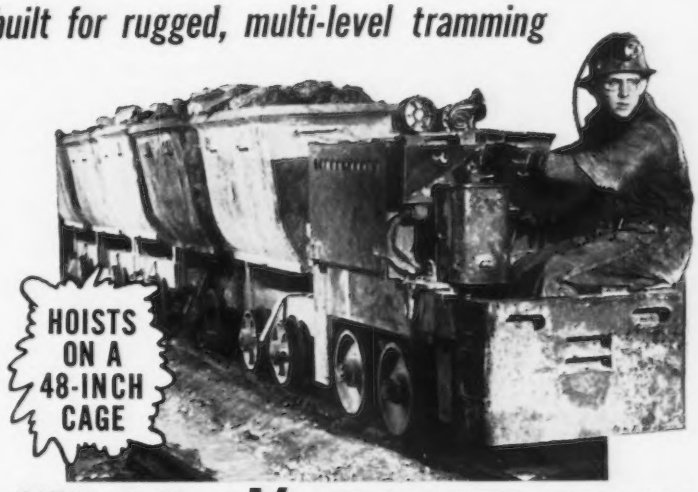

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USSR *(Continued)*

metallogenic map of Sakhalin and the Kuriles where it says a mining industry will be established before long.

Geologists there, it is noted, have discovered deposits of gold, mercury, silver, nickel, tungsten, titanomagnetites, copper and iron ore.

In Uzbekistan, recent discoveries are said to include copper, lead, zinc and tungsten. Major deposits of lead and zinc ores and fluorspar have been found in Tajikistan.

A wide range of minerals also has been located, say the Soviets, in Kirgizia and the Caucasus—the first Soviet furnace for roasting of antimony having recently been built in the former, according to TASS.

However, it appears that Kazakhstan is proving to be the true mineral storehouse of the Soviet Union. It is reported to lead all other Soviet republics in reserves of molybdenum, tungsten and zinc, among others. It also has great reserves, say the Soviets, of copper and such rare metals as titanium, tantalum and columbium.

The extent to which these reserves are being extracted and processed is not clear. However, a spokesman for the trade organization Promsyryeimport told the Soviet press recently that most metal products assigned for export were sold in the first half of 1960, and that 1961 would be another good year.

Antropov has predicted that "within the next few years the Soviet Union will be able to fully satisfy the requirements of the socialist camp countries in iron ore and also export considerable quantities to other European and Asian countries."

Of manganese, he has said "there is enough to meet domestic requirements and sell abroad."

IN LATIN AMERICA

ARGENTINA

Argentina is to invest $2.35-million in the development of the Sierra Grande (Patagonia) iron ore deposits. The government believes this will give tremendous impetus to the Argentine steel industry and that Sierra Grande will, in the near future, be able to supply high-grade ore to the "General Savio" steel mill at San Nicolás, province of Buenos Aires.

CHILE

Chilean copper production has declined in 1960. The decline is mostly due to the long strike in Chuquicamata. Net loss for the year is about 11,000 tons.

Small and medium size copper mines had a record output in 1960. Production increased from 48,300 metric tons in 1959, to about 53,000 tons in 1960. However, this gain could not offset the drop in the production of the big mining companies. The production of the American-owned big mining companies represents over 90% of total copper production.

The big mines produced 431,922 metric tons (electrolitic, blister and fire refined) in the first eleven months of 1960. This represents a decrease of 16,726 tons, over the 448,648 tons produced during the same period in 1959.

The production of iron ore has increased from 1,850,997 tons produced during first six months of 1959, to 2,245,015 tons produced in 1960 during same period.

Gold production (fine) has decreased from 1,375 kg produced during the first six months of 1959, to 912 kg during the same period in 1960.

Silver (fine) production for the first six months of 1960 amounted to 22.951 kgs. This compares with the 25.491 kg produced in 1959 during the same period.

Compañía Minera Tamaya has formed a mixed German-Chilean corporation with Mansfeld in Central Germany. The company will open up the claims Tamaya acquired under option from Señores Zepeda and Barrera, owners of the largest number of claims—some 3000 acres—in the gold-copper camp of Andacollo, located SE of the town of La Serena, Coquimbo Province.

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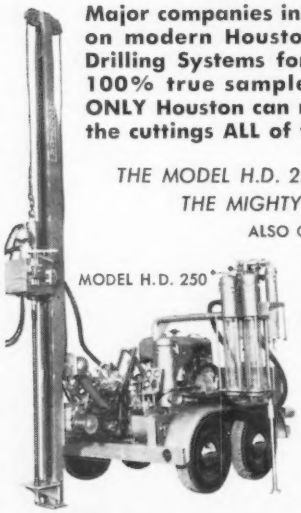
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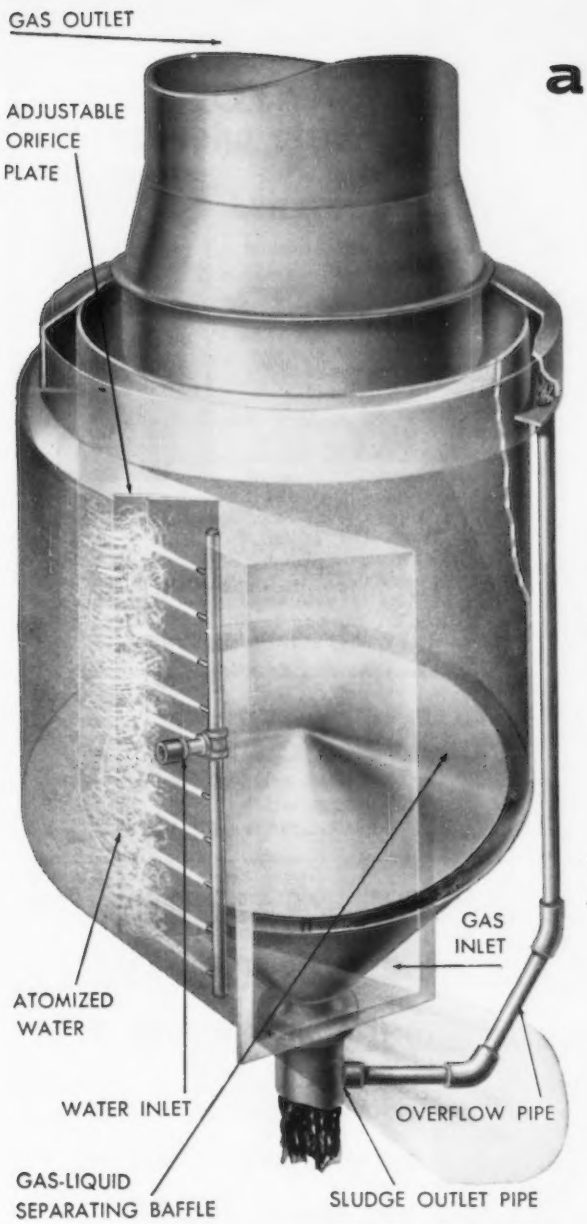

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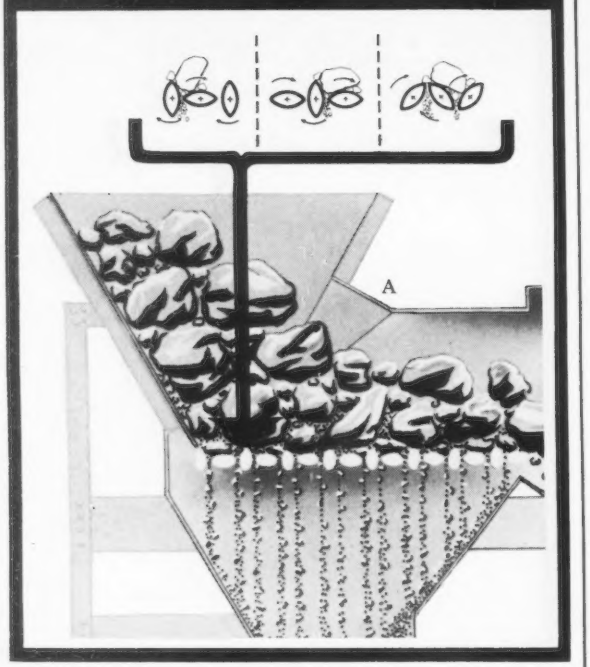

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PERU

As a result of the Toquepala mines of the Southern Peru Copper Corp. entering into production in December 1959, copper has now become the leading export from Peru, in value, displacing the former leaders, cotton and sugar. In 1959, copper was Peru's fourth leading export, in value. Peru's iron production doubled in 1960 compared with the previous year. To further increase iron ore production, Marcona Mining Co. is investing $25-million in a new loading port and a beneficiation plant to up-grade the ore.

A return of confidence in the Peruvian economy and political stability was indicated by the Cerro de Pasco Corp. announcement of a $6.8-million investment for zinc refining expansion, to increase capacity from 32,000 to 52,000 short tons. South American Gold & Platinum is carrying out exploration on several placer properties in the Inambari region of southeastern Peru. Despite continued fear of U.S. restrictions on lead and zinc and world price of metals, the industry was more confident of the future than a year ago.

Preliminary production figures, in metric tons, for 1960 are as follows:

Lead	130,000
Zinc	160,000
Copper	175,000
Iron Ore	4,800,000
Barite	80,000
Silver	700

A reported discovery of rich beds of phosphate rock in the Sechura Desert region of the Departments of Lambayeque and Piura, northern Peru, may add another source of natural wealth.

MEXICO

The big news from Mexico in 1960 has been the new mining law which would favor Mexicans moving into foreign mining operations via tax breaks. Although this law went through the Senate and the House, it is now being held off by the President, possibly until next September, because it is highly controversial.

Major metals fared poorly but nonmetallics, such as fluorspar and sulphur, continue to boom. Sulphur production for 1960 was 1.3-million tons and just slightly under that for exports.

Mexican mining now has more than 70,000 workers and pays around $70-million in taxes. Exports of minerals account for better than 30% of all Mexico's foreign dollar earnings.

The Japanese firm, Howa Co., is now going into Mexico on a regular mining basis—they had previously been prospecting only.

Mexico Mineral Production
(First nine months, 1960)

Gold	7,159.9 kg
Silver	979,960.4 kg
Lead	134,561 tons
Copper	45,521 tons
Zinc	192,815 tons

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1—20 NM2C Ing. Rand, 2 drum, 20 H.P. 440 V.
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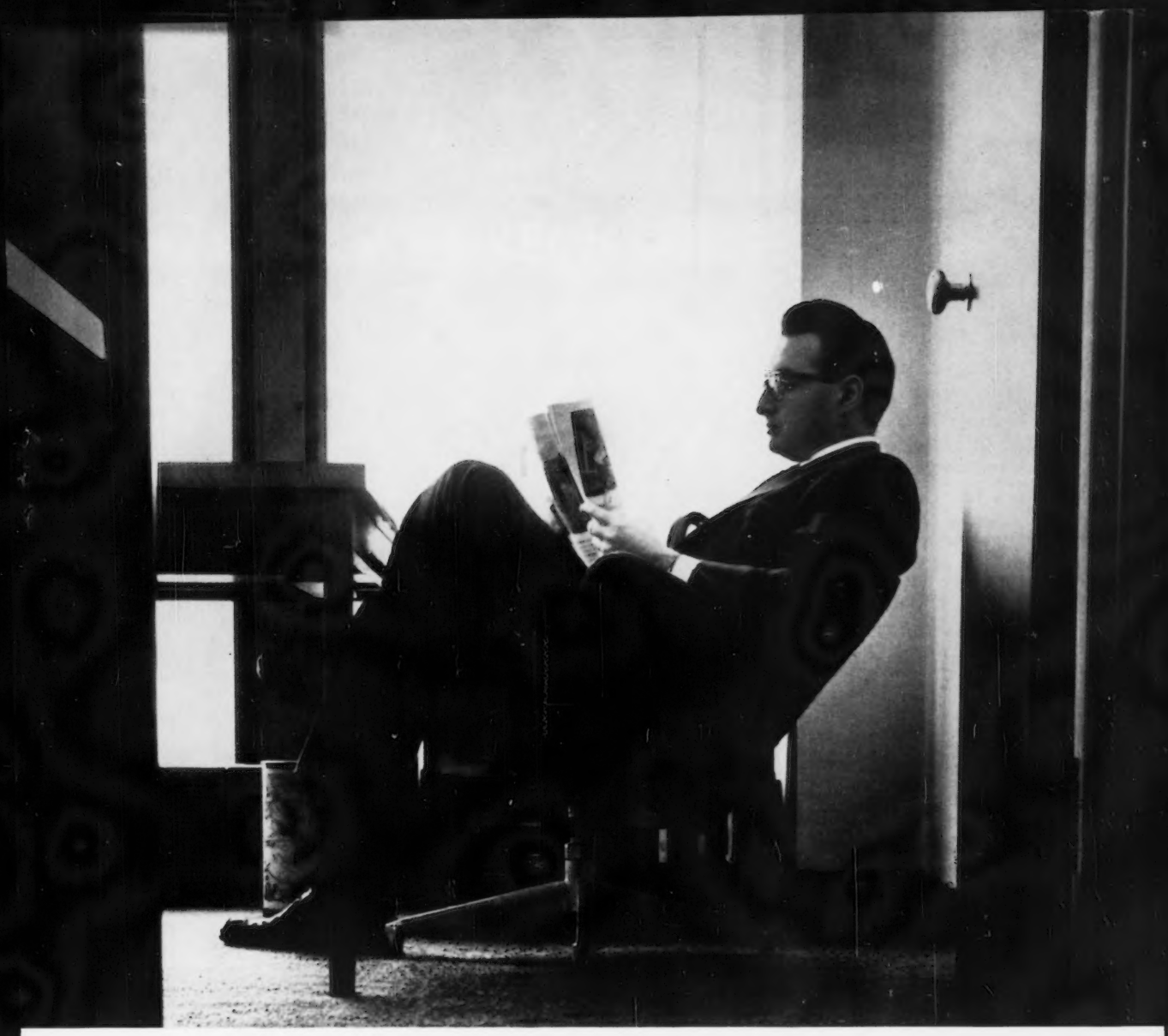

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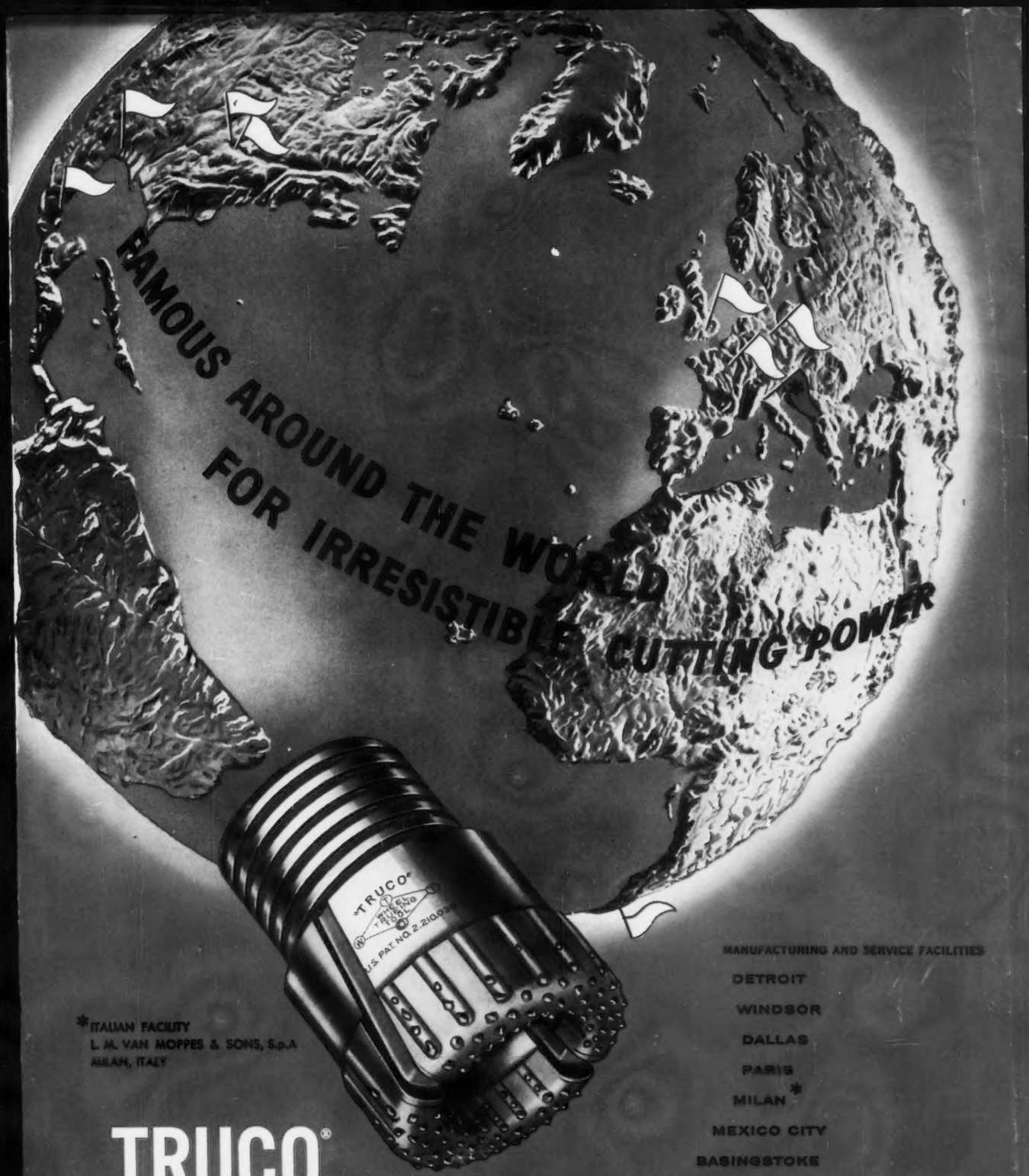

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